CHEMICAL EXPOSITION AND BUYERS' GUIDE ISSUE

CHEMICAL & METALLURGICAL ENGINEERING

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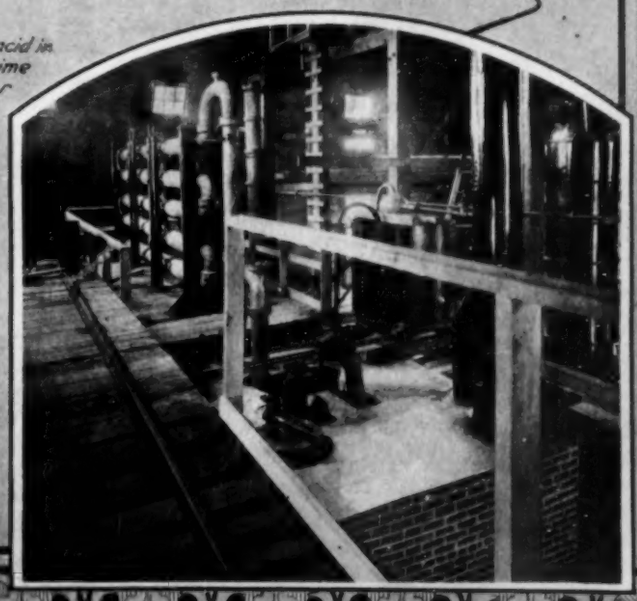
We have probably the highest ingenuity and efficiency in the operation of our individual industries of any nation. Yet our industrial machine is far from perfect. The waste of unemployment during depression; from speculation and overproduction in booms; from labor turn-over; from labor conflicts; from failure of transportation, fuel, and power supplies; from excessive seasonal operation; from lack of standardization; from loss in our processes and materials --all combine to represent a huge deduction from the goods and services that we might all enjoy if we could do a better job of it.

One hundred per cent is never possible in the material world, but the primary duty of organized society is to enlarge the lives and increase the standards of living of all the people, not of any special class whatever. The opportunity for advance in living standards lies more surely in the steady elimination of these wastes than in great inventions.

Herbert Hoover

Making nitric acid in Agricola's time and ours



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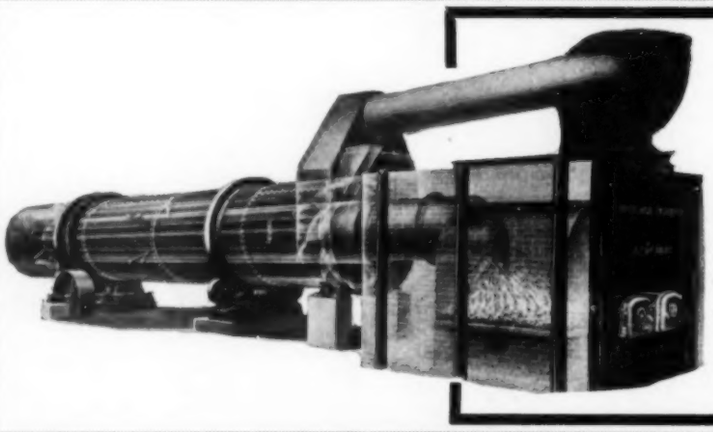
See pages 164, 165



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For useful information on the handling of drying problems, turn to Pages 83-86 of this issue, and visit Booth No. 69 at the Chemical Exposition, Eighth Coast Artillery Armory, week of September 12th.

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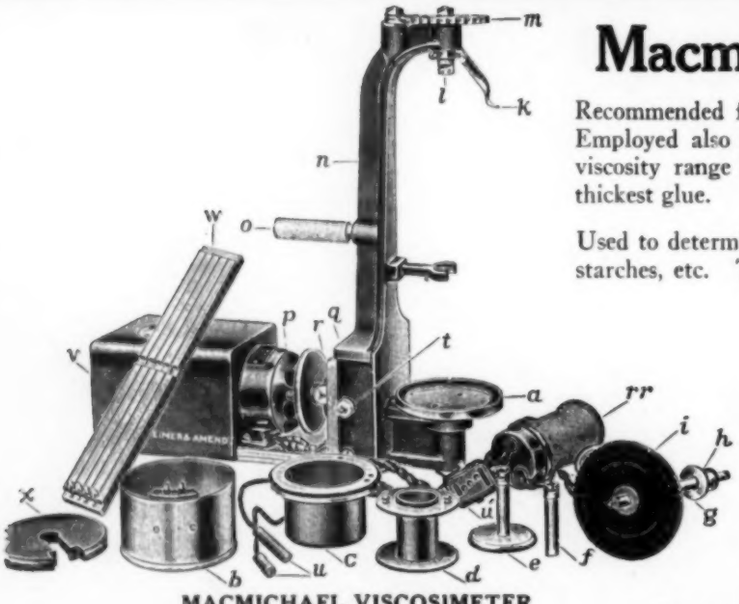

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Macmichael Viscosimeter

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Used to determine the "body" of cocoa solutions, patent medicines, starches, etc. The instrument is portable and rugged in construction. Technical training is not required to operate. The motor is universal for A.C. or D.C. In ordering, advise voltage of current, also approximate range of viscosity of the materials to be tested, so that suitable torsion wires may be supplied.

See our Exhibit at the SEVENTH NATIONAL EXPOSITION CHEMICAL INDUSTRIES New York City Sept. 12-17 1921

See our advertisement on pages 200, 201 in this issue.

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A consolidation of
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The Cover Of This Number

MANY minds have collaborated in the production of this number of CHEMICAL & METALLURGICAL ENGINEERING. Author, manufacturer, editor, printer, artist—each has contributed out of the abundance of his knowledge and resources to produce for the reader a work of exceptional utility. It is altogether fitting, therefore, that the cover should foreshadow the excellence of the contents. The reader will at once be struck with the keynote which Mr. HOOVER has contributed specially for this occasion. With clear vision he sees the loss to the human race "in goods and services" due to waste and inefficiency in our industrial processes; and though he addresses a profession characterized by inventive genius that has been responsible for much of the marvelous progress of our time, he nevertheless asserts that greater good will result from the elimination of waste in industry than from great inventions.

Typical of the improvements in technology that have increased efficiency and reduced waste are the illustrations of the methods of making nitric acid in AGRICOLA'S time and today. The illustration of the crude firebox with its retorts and condensers, reproduced from the Hoover translation of AGRICOLA'S *De Re Metallica*, is in sharp contrast to the modern plant shown in part in the adjoining picture.

For the border design the artist has appropriately adapted a decoration from old German pottery of the time when AGRICOLA flourished.

Elimination of Waste in Industry

WASTE and inefficiency are the twin evils that today threaten American industry from within. They are dangerous characteristics because of their insidious nature, and they are reprehensible because generally they are remediable. Blameworthy at all times, they are especially so when avoidable waste and increased efficiency offer the quickest and surest opportunities for reducing losses or increasing profits. The elimination of waste is something that is within our control if we but give thought to it, in contradistinction to those fundamental economic forces that work inexorably and against which it is useless for us to strive.

In casting about for an editorial theme for this annual number of CHEMICAL & METALLURGICAL ENGINEERING, it seemed both wise and appropriate to make a contribution to the elimination of industrial waste. The whole world is recovering from an orgy of economic waste followed by a revel in extravagance such as we have never seen. Heedless of warnings and forgetful of the lessons of other wars and periods of reconstruction, we have approached the very brink of industrial disaster. In some cases it was necessary to meet ruin face to face in order to recognize it. And much of this distress occurred in the very presence of industrial wastes the removal of which would have alleviated conditions, if indeed it would not have remedied them. Mr. HOOVER was right when, through American Engineering Council, he directed a survey of industrial waste as the most important investigation engineers could undertake.

Our readers will find the theme treated editorially in a variety of phases. It is reflected throughout the advertising pages as well, because it lends itself to the message of progressive manufacturers. If waste should be at a minimum anywhere, it is in the technologic industries that are founded on science and engineering. And yet, as will be shown later, there are vast opportunities for improvement even in those that are best regulated.

The contents of this number will fall naturally into two classes—a series of major articles on topics of broad interest and application, and a collection of brief surveys of the outstanding causes of waste and inefficiency in more than a score of industries. The major symposium opens with a study of human waste—that intangible charge against industry which is gradually being reduced to definite terms. Human effort is the foundation of industry, and accordingly the problems of health, food, housing, sanitation and recreation become the problems of industry; and the factors of contentment, loyalty and confidence assume a hitherto unrecognized degree of importance. Dr. MOCK finds that we have been as prodigal of human life and limb as of natural resources, and his solution of the problem is found in co-operation between engineers and physicians. Dean KIMBALL of Cornell contributes a thoughtful article on waste due to poor engineering and management, discussing the waste of materials and labor and the elusive waste due to idle equipment. Lost time due to poor planning, and depreciation of material due to poor storage or unwise purchasing are direct charges against poor management.

It will be recalled that the report of American Engineering Council charged management with responsibility for 50 per cent of present industrial waste. In discussing in this number the educational waste in industry Dr. HOLLIS GODFREY boldly lays responsibility for this condition back upon our educational institutions, believing as he does that the waste due to management "never could exist had there been proper co-operation between colleges and industry in the past." In his judgment "education is the salvation of industry," and the college man, properly trained, is badly needed. The rôle of scientific research in waste elimination is ably presented by HARRISON E. HOWE, who shows the great need for fundamental research in pure science in order to lay the groundwork for industrial research. The fallacy of curtailing or abandoning research in times of industrial depression and the tremendous cost of this policy are strikingly elucidated.

Doubtless we shall have to talk about standardization of chemicals and trade specifications for some time before they are accomplished facts. Two phases of the waste due to lack of these things are ably presented in this number. WALLACE P. COHOE stresses the losses in raw materials and finished products which result from lack of careful standardization, and WELLINGTON GUSTIN lays bare the appalling waste in litigation arising from the same cause. Litigation seems to be an inevitable consequence of doing business, but it is the height of folly to invite it by failing to know in advance the basis on which business is being done. Without standardization and trade specifications, buyer and seller not only have no common ground on which to initiate business but they have no accepted authority to which they can turn in case of dispute. The consequence is a waste in litigation that is a considerable charge against industry.

Are you wasting time and production in your industry due to lack of personnel selection and training? If such a problem confronts you, you will find food for thought in the article by L. B. HOPKINS. Improper selection of personnel is responsible for the waste inherent in high labor turnover, and failure to recognize the value of training, transfer and promotion of deserving employees adds another unnecessary burden to industry. Of the same order of magnitude is the waste due to lack of efficient cost-accounting methods, as set forth by ERNEST J. WESSEN. In this connection it is refreshing to read that in devising an efficient system of cost-finding "a knowledge of engineering practice is indispensable." Familiarity with bookkeeping and clerical methods will not suffice.

Building construction is likely to be more active in the near future than it has been for some years past, and accordingly we may give thought profitably to the elimination of construction wastes. Mr. BURPEE gives us a comprehensive analysis of the preventable wastes in this important industry, reducing to dollars and cents the cost of such items as abnormal risk, accidents, labor turnover, restriction of output and manner of letting contracts. Having built our factories after much planning and effort, we are apparently lax in protecting the structures against fire hazard. Our country has an annual fire waste amounting to about a quarter of a billion dollars, according to figures given in the article by NICHOLAS RICHARDSON. His review of fire hazards should prove specially valuable to the chemical industry. A related cause of waste and loss, and one that has not received the consideration it needs, is the location of industrial plants. Out of a large experience V. V. KELSEY discusses the influence which a proposed industry will have on the community, and the accessibility of raw materials, transportation, labor and power.

Closely related to other phases of the human problem in industry is that of accident prevention. Mr. DEBLOIS shows how attention to this factor can reduce waste and increase efficiency. The industrial accidents of the chemical industry should be carefully studied and analyzed as a basis for future precautionary measures. Some accidents are due to poor lighting, as WARD HARRISON points out in his article on the waste due to poor illumination. But there are other wastes chargeable to this neglected factor: time, materials and production are lost for want of enough light properly distributed throughout the factory.

The importance of machinery—automatic machinery—in modern industry has been emphasized of late by the scarcity of labor and the tendency toward restriction of output. Mr. HIRES makes an excellent case for automatic machinery as a substitute for hand labor, showing that it is at once more efficient and economical as well as superior in its product. Closely related to mechanical operations are the production and use of power. There is a double interest in the subject for the chemical industries, because they usually want heat as well as power, and the question will arise whether to purchase from a central station or install an individual power plant. DAVID MOFFAT MYERS answers this question in his article on elimination of waste in power plants.

The problem of distributing and marketing the products of manufacturers is ably discussed by WILLIAM R. BASSET, who shows that faulty marketing represents a waste that is an unnecessary deduction from profit. It frequently happens that the manufacturer is weakest in his knowedge of marketing methods. He may know how to buy raw materials, and we may assume that he manufactures his product efficiently and economically, but there is ample evidence that he fails woefully at times to adopt the best selling policy. Mr. BASSET'S article discusses the subject from the point of view of the manufacturer.

The economic waste and nuisance inherent in the smoke, fume and gas discharged from industrial plants is a charge against industry that has been reiterated by investigators until it is pretty well understood by even the man on the street. A great deal is constantly being done to eliminate this waste, but a vast amount remains to be accomplished. For this reason Mr. LANDOLT'S article is a welcome contribution to the symposium. His analysis of methods for reducing this economic waste will be helpful to many industries.

The relation of the patent situation to industrial waste may not be apparent at first glance, but when one stops to think of the needless delays, the interferences and the litigation which industry incurs due to a poorly manned Patent Office, no excuse need be made for including Mr. PRINDLE'S forceful article in our treatment of this theme.

The series of short articles featuring the outstanding causes of waste and inefficiency in the industries will have a fascination for the reader because of their frankness, if for no other quality. We regard them, however, as valuable contributions on the part of men who are fully cognizant of technical and economic conditions internal to their respective industries. Some of the contributions are anonymous or offered under *noms de plume* for the reason that the authors felt they could thus speak more frankly. The value of their criticism, however, is not diminished, but rather enhanced, by failure to disclose their identity. On the whole we regard the symposium as a notable contribution of its kind.

The contents of this number will not be digested at one sitting, nor in a week or a month. The contributors are specialists and authorities, and have written out of a large experience. The magazine thus acquires a reference value out of the ordinary. Nor does this apply to the text pages alone; equally careful attention has been given to the preparation of the advertisements so that they form a very practical guide to the industry. The entire number will be worthy of preservation intact regardless of the reader's practice with respect to binding volumes.

Chemical Exposition for 1921 To Excel Its Predecessors

IT has been characteristic of the National Exposition of Chemical Industries that each annual exhibit surpassed the preceding one, both as to the number of exhibitors and amount of floor space covered. To this general rule the 1921 show will be no exception. The space occupied by exhibits will be considerably larger than in 1920 and the number of exhibitors will exceed those of a year ago by a small number. Various interpretations might be put on this record, but in view of prevailing industrial conditions we think it is a tribute to the stability of American chemical industries and to the inherent optimism of their executives. A year ago, in the face of impending business depression, exhibitors gladly committed themselves to participation in this year's exposition. There have been some additions to and some subtractions from the list since that time, but on the whole, preparation for this year's show has been carried out in the face of obstacles that would daunt a less courageous industry.

Many conditions this year will contribute to make the exposition more satisfactory to the visitor than in past years. In the first place, the use of the Eighth Coast Artillery Armory will make it possible to present the entire exposition on one floor. This is not only a great physical advantage, but it will have a tremendous psychological value in enabling the visitor to get a better conception of the magnitude of the show and the industry it represents. For the first time appropriate provision will be made for the technical sessions and display of industrial motion pictures. Hitherto speakers and audience at these sessions have been disturbed by the noise of moving machinery and the crowds, but this year they can enjoy the programs in a room well apart from the main exhibition floor. The technical sessions are growing in favor and improving in value and are coming to be recognized as an important feature of the exposition. This year there will be a number of interesting symposia on industrial subjects and some of the papers will be preprinted. Taken all together, the exposition this year will excel its predecessors and will be far more satisfactory from the point of view of the visitor.

Five Years of Legislative Waste

WASTE in government is as old as government itself and many methods have been proposed for its elimination. The investigations of congressional committees, the reorganization schemes of the Bureau of Efficiency and the Director of the Budget, the work of the joint commission on reclassification—all are steps in this direction which may be expected to accomplish many worth-while savings. As long, however, as the lion's share of our appropriations continues to be spent for the upkeep of the Government's fixed establishments of Army and Navy, the economies effected by these agencies must necessarily be limited.

There is a source of waste in government which we hear less about but which cannot have escaped the attention of those who have followed the efforts to obtain protective legislation for the dye industry. The first genuine attempt on the part of the chemists of the country to obtain recognition for this important industry was in 1916 and the history of what has transpired since that time is a record of disappointing delays and discouraging wastes of time and effort. Progress has been extremely slow and the occasional successes accomplished have been only temporary. For five years the industry has had to keep up a continuous battle. It has been necessary to tell its story many times and in many places. Its case has been argued before the Ways and Means Committee on at least four separate occasions and each time the case has been retried before the Senate Finance Committee. Many volumes of testimony have been recorded and printed by each committee notwithstanding the fact that few if any new arguments were advanced at the subsequent hearings.

For the benefit of those who have not followed the details of these legislative activities, let us review them briefly. The measure previously referred to was passed by Congress on September 8, 1916. It had been sponsored by a committee of the American Chemical Society and in its final form it provided slightly increased duties on dyes and intermediates for a period of five years. It was soon evident, however, that the new law was unsatisfactory in many ways and in December, 1918, the Tariff Commission officially called attention to the urgent need for its revision. In May, 1919, President WILSON in his annual message to Congress declared that "special consideration should be given to the manufacture of dyestuffs and related chemicals." A few days later the original Longworth bill was introduced and was referred to the Ways and Means Committee and extended hearings were held. At that time Army and Navy representatives testified to the importance of the industry from the standpoint of national preparedness. Shortly afterward a second bill was reported and referred to the committee for hearings. Finally, in September, 1919, the Longworth dye-licensing bill was passed by the House and, following the usual procedure, was sent to the Senate Finance Committee, which devoted several months to hearings on the subject. In the meantime the President's message to the Sixty-sixth Congress had repeated the earlier appeal for special dye legislation. In February, 1920, the modified selective embargo was reported to the Senate, but three months later it was defeated without a vote principally because of the persistent filibuster by Senators THOMAS and MOSES. Early in the present year the Ways and Means Committee held hearings on the general tariff revision and on June 29 reported the Fordney tariff. Before this measure was passed, on July 21, it will be recalled, the House eliminated the dye embargo, due largely to Congressman FREAR'S insistence that a monopoly was being fostered. And now the Senate Finance Committee has just concluded another series of open hearings and, although the chemists have again made a strong appeal for the industry, the embargo question, still unsettled, has been referred to a joint sub-committee.

Such is the story of the dye bill—a measure which has been recognized as essential to the national defense, a non-political question supported by free trader and protectionist alike. Five years has elapsed and nothing permanent has been accomplished. Hearings have followed hearings, licenses and embargoes have been discussed and discarded, wartime control of imports has been extended and re-extended, and we now find ourselves just about where we started. It is obvious that our law-making processes are truly wasteful.

After such a condemnation of our legislative system, we should like to suggest a practical remedy. We hesitate, however, to approve the theoretical solution which

is so often proposed—viz.: Take the tariff out of politics; put it into the hands of a non-partisan tariff commission and give that body complete authority to deal with all tariff matters. If the tariff were more of an economic problem and less of a political factor, such a change might perhaps be accomplished. A compromise solution which appears to us to have some advantages over the present system would be to let the Tariff Commission take over all of the investigational work of the tariff and conduct all tariff hearings. The facts presented to Congress by this impartial body would then be used as the basis for our tariff legislation. The wasteful duplication of hearings and needless political debate would thus be eliminated and with this much accomplished we could look forward to more radical changes in our legislative processes.

The Man on The Firing Line

IN THE preparation of that part of this number which tells of the outstanding causes of waste and inefficiency in a score or more of industries we have naturally had a great deal of correspondence. Our effort has been to select the man available who is best equipped in each case and then to give him a free rein. It has seemed to us that this would be of greater value to our subscribers and more profitable to them than to wind ourselves up in rhetoric over the bigness, the grandeur—over what LAFCADIO HEARN once called "the ahness" of American chemical enterprise.

We wrote, among others, to a leading technologist who replied as follows:

> Please excuse me from writing on the causes of waste and inefficiency in the —— industry. A man on the firing line cannot comprehensively report a battle. He is too close and his vision is too limited. For that very reason I shall all the more appreciate the articles of those who have a broader vision or who can view the scene at a better perspective.

There would seem to be an anomaly in this, that the man on the job every day should fail to see that which is obvious to the stranger or the more casual observer. But we appreciate his point of view. It is not alone with distant forests that we cannot see the trees for the woods. We suffer a similar inhibition among familiar things that are right before our eyes. When a thing is settled, a problem solved and things are working smoothly, we naturally close our minds to further worry over the subject and address our attention to those things which we believe need it. The single-track mind is the usual mind, and we know well that our best method is to do one thing at a time and to strive to do it well. Then it is likely to happen that certain features which have had attention and have been adjusted in times past suffer from neglect because in the march of progress they have been overlooked. That which two years ago seemed excellent is not good enough for today. And the man responsible does not realize it. There is not a person alive who is up to date in every respect.

It is therefore very profitable for men on the firing line to have their work looked over occasionally. A critical audit of a plant is as important as an audit of books. There is no establishment so well run as to be beyond criticism or incapable of improvement from it. Whoever thinks that he has achieved perfection or that his work is above criticism is, by that very token, a back number. He has lost his scientific spectacles if he thinks so.

Chemical Supremacy With English-Speaking People

A HEARTY welcome is extended to British and Canadian chemists representing the Society of Chemical Industry who expect to spend the next two weeks in the United States. This will afford an opportunity for exchange of views and opinions and for a more intimate knowledge of chemical and industrial conditions on the part of hosts and visitors. These international visits are better guarantees of peace and amity than are treaties concluded by statesmen and diplomats.

But there is a deeper significance in the conclave of British, Canadian and American chemists in New York next week than will appear in the mere fraternizing of men who are already more or less well known to each other by reputation or through correspondence. True, the British have crossed the water, which is in itself no mean undertaking in these piping times of peace and reconstruction. And Canada is putting her best chemical foot forward, as befits a hostess who would honor eminent guests that have journeyed far in the name of the Society of Chemical Industry. And finally, British and Canadians will converge upon New York to meet with the American Chemical Society and visit the Chemical Exposition. The bare incidents are noteworthy, but in our judgment they mark an epoch. This international meeting of chemists lays the foundation for the recognition of chemical supremacy in the English-speaking people.

We might almost speak of the restoration of chemical leadership to the Anglo-Saxon race, for the early history of the science abounds in names of English rather than of Gallic or Teutonic investigators. Curiously enough, the diligence and industry of the Teuton in applying the fundamental discoveries and developments of his neighbors earned for him the reputation of being the repository of all chemical knowledge. And he capitalized on this reputation through his literature and universities, until it required a great war to disillusion the rest of the world and awaken a sense of equality and independence in science, particularly chemistry.

Signs are not lacking that the old order changeth, one of which is the fact that no longer are we dependent on German chemical literature for knowledge of what is being done by, say, Russian or Japanese investigators. As DR. BENJAMIN T. BROOKS points out in private correspondence, an increasing proportion of research and investigation done in foreign countries is being published in English, whereas formerly the German language was the medium through which most of us acquainted ourselves with the work originally published in Russian, Scandinavian, Dutch or Italian. German has been the accepted language of international chemistry, much as French has served in international diplomacy. Our own *Chemical Abstracts*, however, now presents abstracts directly from Russian and Japanese publications, and doubtless the work will be extended to the point where former dependence on *Chemisches Centralblatt* will be a vanishing quantity.

This is but one of the factors contributing to English-speaking leadership in chemistry, which is a consummation that, in our judgment, will come in due course. The international gathering of chemists in New York should be another powerful impetus toward the same end, and we express the hope that these benign forces may continue to act until English merits the distinction of being the international language of chemistry.

OFFICERS AND SOME OF THE VISITORS AT THE MONTREAL MEETING, WEEK OF AUG. 29, 1921, OF THE SOCIETY OF CHEMICAL INDUSTRY (BRITISH) AND AT THE NEW YORK CITY JOINT MEETING, WEEK OF SEPT. 6, 1921, OF THE AMERICAN CHEMICAL SOCIETY AND OF THE SOCIETY OF CHEMICAL INDUSTRY

1—Sir William J. Pope, president of the Society of Chemical Industry.
2—R. F. Ruttan of Montreal, president-elect of the Society of Chemical Industry.
3—S. R. Church of New York City, member of the co-ordinate committee for the joint meeting at New York of the American Chemical Society and of the Society of Chemical Industry.
4—J. P. Longstaff, Secretary of the Society of Chemical Industry.
5—E. V. Evans, honorary treasurer of the Society of Chemical Industry.
6—F. W. Atack, Editor of Chemists' Year Book.
7—R. H. Clayton of the Manchester Oxide Co.
8—F. W. Gamble, of Allen & Hamburg, Ltd.
9—C. S. Garland, chairman of Lighting Trades, Ltd.
10—Captain C. J. Goodwin, honorary treasurer of the Chemical Industry Club of London.
11—L. A. Jordan of the British Xylonite Co., Ltd.
12—J. D. McBain, professor of physical chemistry at the University of Bristol.
13—J. MacWilliam, consulting metallurgist, of Sheffield.
14—H. W. Matheson, vice-president of the Canadian Electric Products, Ltd.
15—J. Reid of the Caldercruix Paper Mills, Airdrie, Scotland.
16—Andrew Smith, managing director of Leech, Neal & Co., Ltd.
17—T. H. Wardleworth, of Canada, member of the General Council of the Society of Chemical Industry.

Program of the Exposition

Symposia Prepared by the Management on Crushing, Grinding and Pulverizing, Evaporating and Drying, Paint and Varnish, Power Plant in the Chemical Industries, and American Dyes—Motion Pictures of a Wide Variety of Industrial Operations

FOLLOWING is the program of the Seventh National Exposition of Chemical Industries, to be held at the Eighth Coast Artillery Armory, Kingsbridge Rd. and Jerome Av., New York City, Sept. 12 to 17. The program as given here is subject to changes and additions:

MONDAY, SEPT. 12

2 p.m. Exposition opens.

7 p.m. Motion pictures (in Auditorium).

1. "Iron Mining Operations" (4 reels), courtesy U.S.B.M.*
   a. Stripping.
   b. Exploration and stripping.
   c. Underground mining.
   d. Logging operations.
2. "The Story of Abrasives" (4 reels), courtesy the Carborundum Co. and U.S.B.M.
   a. Creating power from water.
   b. Within the power plant at Niagara.
   c. In and about the City of Niagara Falls.
   d. Power at work in the Carborundum Plant.
   e. Making the crystal masses in the electric furnace
   f. and making them into stones, grinding wheels, paper and cloth.
   g. Unusual and usual uses for abrasives in fifty industries.

8 p.m. Opening addresses.

Dr. Charles H. Herty, opening address.
Hon. Irvine L. Lenroot, United States Senator.
General Amos A. Fries, Chief, Chemical Warfare Service.

TUESDAY, SEPT. 13

2:30 p.m. Crushing, grinding and pulverizing symposium. Chairman, Harry J. Wolf.

H. F. Kleinfeldt, Abbe Engineering Co., "Ball and Pebble Milling for Pulverizing and Mixing."
S. B. Kanowitz, Raymond Bros. Impact Pulverizer Co., "Grinding and Pulverizing With Air Separation."
L. H. Sturtevant, Sturtevant Mill Co., "Crushing, Storing and Pulverizing."
M. I. Dorfan, Allis-Chalmers Manufacturing Co., "Dust Collection as Applied to Grinding and Pulverizing Problems."
H. Schifflin, Allis-Chalmers Manufacturing Co., "The Development of Compound Grinding Mills."
G. W. Repetti, the Dorr Co., "Mechanical Handling of Finely Ground Wet Material."

Industrial Problems:

H. Austin, Ernest Scott & Co., "Solvent Extraction of Edible Fats and Oils."
R. H. McLain, General Electric Co., "Materials Handling in Industrial Plants."
W. H. Dickerson, Industrial Products Co., "Utilization of Industrial Waste; Its Economic Importance."

To be followed by motion pictures upon the subject of the handling of materials if time permits. See the first four titles upon the evening program.

7 p.m. Motion pictures.

1. "Transportation and Storage of Iron Ore" (1 reel), courtesy U.S.B.M.
2. "The Story of Asbestos" (4 reels), courtesy U.S.B.M.
3. "Dredging Anthracite Coal" (1 reel), courtesy U.S.B.M.
4. "Saving Wasted Millions Through Material Handling Equipment" (2 reels), courtesy Economy Engineering Co.
5. "The Story of Sulphur" (2 reels), courtesy Texas Gulf Sulphur Co.
6. "Mining and Extraction of Radium From Carnotite Ore" (2 reels), courtesy U.S.B.M.
7. "DuPont Dyes," showing their manufacture (2 reels), courtesy du Pont de Nemours & Co.
8. "Making Soap" (1 reel), courtesy Baumer Films.
9. "Mine Explosion and Rescue" (1 reel), courtesy U.S.B.M.

8 p.m. Address, Hon. Fred S. Purnell, Representative from Indiana.

WEDNESDAY, SEPT. 14

2:30 p.m. Evaporating and drying symposium. Chairman, Wallace Savage.

E. G. Rippel, Buffalo Foundry & Machine Co.
A. E. Stacy, Jr., Carrier Engineering Corporation, "The Relation of Atmospheric Conditions to Chemical Processes."
H. S. Landell, Proctor & Schwartz, "Drying and Dying Problems."
Max Donauer, Elyria Enameled Products Co., "Special Problems for Enameled Evaporators."
Arthur B. Stonex, Hunter Dry Kiln Co., "Drying With Moist Air."
A. W. Lissauer, W. L. Fleisher & Co., Inc., "Drying as an Air-Conditioning Problem."
J. D. Stein, Grinnell Co., Drier Division, "Atmospheric Drying by Means of Compartment, Tunnel and Continuous Belt Conveyor Driers With Some Practical Applications."
W. H. Dickerson, Industrial Waste Products Co., "Spray Drying."
H. Austin, Ernest Scott & So., "Evaporation."
Robert V. Cook, Chemical Equipment Co., "The Criss-Cross Evaporator: Why It Was Designed, What It Is, and What It Does."
J. S. Chen, J. P. Devine Co., "Vacuum as Applied to Industry."

7 p.m. Motion pictures.

1. "The Manufacture of Dry Sausage" (2 reels), courtesy Armour & Co.
2. "The Making of Oleomargarine" (1 reel), courtesy Armour & Co.
3. "The Electric Heart—The Dry Cell" (1 reel), courtesy Baumer Films.
4. "Canning Electricity—The Wet Cell" (1 reel), courtesy Baumer Films.
5. "The Manufacture of Pyrex Glassware" (3 reels), courtesy Corning Glass Co.
6. "The Manufacture of Portland Cement" (2 reels), courtesy U.S.B.M.
7. "The Manufacture of Dynamite" (1 reel), courtesy U.S.B.M.
8. "Exterminate the Mosquito" (1 reel), courtesy U.S.B.M.

THURSDAY, SEPT. 15, PAINT AND VARNISH DAY

2 p.m. Paint and Varnish Symposium.

Chairman, R. S. Perry, Perry & Webster, Inc., "Paint and Varnish Waste Control."

H. A. Gardner, Institute of Paint and Varnish Research, "Reflection Factors on Industrial Paints."

*NOTE: "U.S.B.M." on this program refers to United States Bureau of Mines.

L. P. Nemzek, du Pont de Nemours & Co., "Laboratory Control."
Maximilian Toch, Toch Bros., "Rust: Its Cause and Prevention."
Frank G. Breyer, New Jersey Zinc Co., "Physical Testing of Paints and Paint Materials."
F. P. Ingalls, John W. Masury & Co., "The Ideal Paint and Varnish Specifications."
D. A. Kohr, Lowe Bros. Co., "Limitations of Standardization of Paint and Varnish Manufacture."

7 p.m. Save the surface; paint and varnish speakers and motion pictures.

Ernest T. Trigg, chairman, "Save the Surface" Committee, Paint Manufacturers Association of the U. S., "Save the Surface and You Save All With Paint and Varnish."
G. P. Heckel, secretary, Paint Manufacturers Association of the U. S., "What Is Paint?"
To be followed by motion pictures.

1. "Making White Lead" (2 reels), courtesy Bureau of Commercial Economics and National Lead Co.
2. "Making of Varnish" (1 reel), courtesy Bureau of Commercial Economics and Murphy Varnish Co.
3. "Making of Paint and Varnish" (2 reels), courtesy Bureau of Commercial Economics and Sherwin-Williams Co.
4. "Making of Paint (1 reel), courtesy Bureau of Commercial Economics and Lowe Bros.
5. "Making of Paint" (1 reel), courtesy Bureau of Commercial Economics and Mathews & Co.
6. "Making of Varnish" (1 reel), courtesy Bureau of Commercial Economics and Taylor, Tregent & Co.
7. "The Manufacture of Pyrex Glassware" (3 reels), courtesy Corning Glass Co.
8. "The Manufacture of Portland Cement" (2 reels), courtesy U.S.B.M.

FRIDAY, SEPT. 16

2:30 p.m. The Power Plant in the Chemical Industries Symposium.
Chairman, R. C. Beadle, Editor, *Combustion*.

R. M. Gordon, the Solvay Process Co., "Modern Boiler House Arrangement and Equipment" (illustrated).
John Primrose, Power Specialty Co., "Suggestions for Reducing Heat Losses in Chemical Plants."
E. C. Bashore, Rice & Bashore, "Boiler Feed Water Treatment and Treatment Control."
A. R. Stevenson, Jr., General Electric Co., "Compressed Air Installations in Industrial Plants."
D. B. Rushmore, J. A. Seede and E. Pragst, General Electric Co., "The Application of Electric Power in Chemical Industry."
F. G. Anderson, Morse Chain Co., "The Limitation of Silent Chain Drive."
D. S. Chamberlain, Distillation Industries, Inc., "A New Method for Coking Coal as Required for Industrial Fuel."
H. S. Savage, Combustion Engineering Co., "The Application of Pulverized Fuel."
Perry West, Anti-Corrosion Engineering Co., "The Prevention of Internal Corrosion in Pipes, Tanks and Other Iron and Steel Equipment."

7 p.m. Motion pictures.

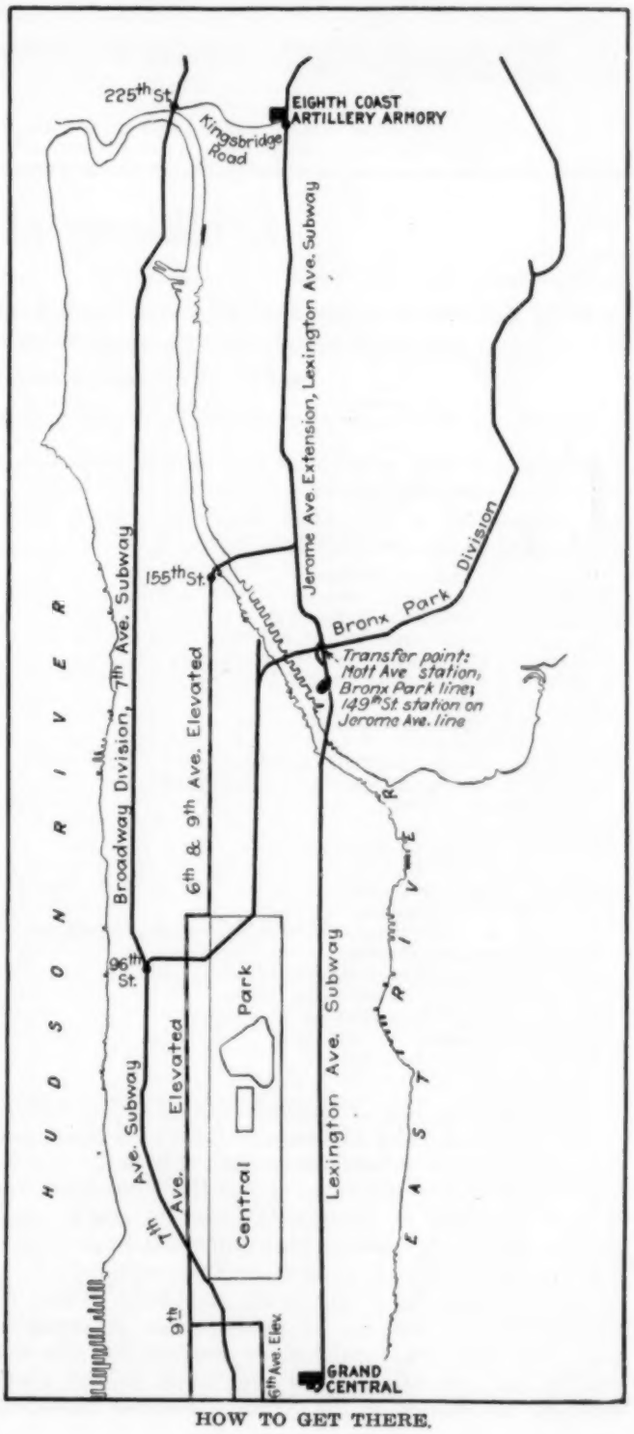
1. "The Cost of Careless Firing" (2 reels), courtesy U.S.B.M.
2. "Getting the Most Out of Coal" (1 reel), courtesy U.S.B.M.
3. "Conserving Coal and Saving Heat Values by Insulating Steam Pipes and Boilers" (1 reel), courtesy Magnesia Association of America.
4. "Modern Byproduct Coking" (2 reels), courtesy the Koppers Co.
5. "The Story of Rock Drilling (4 reels), courtesy Sullivan Machinery Co., and U.S.B.M.
6. "The Story of Armco Ingot Iron" (3 reels), courtesy American Rolling Mill Co.

SATURDAY, SEPT. 17

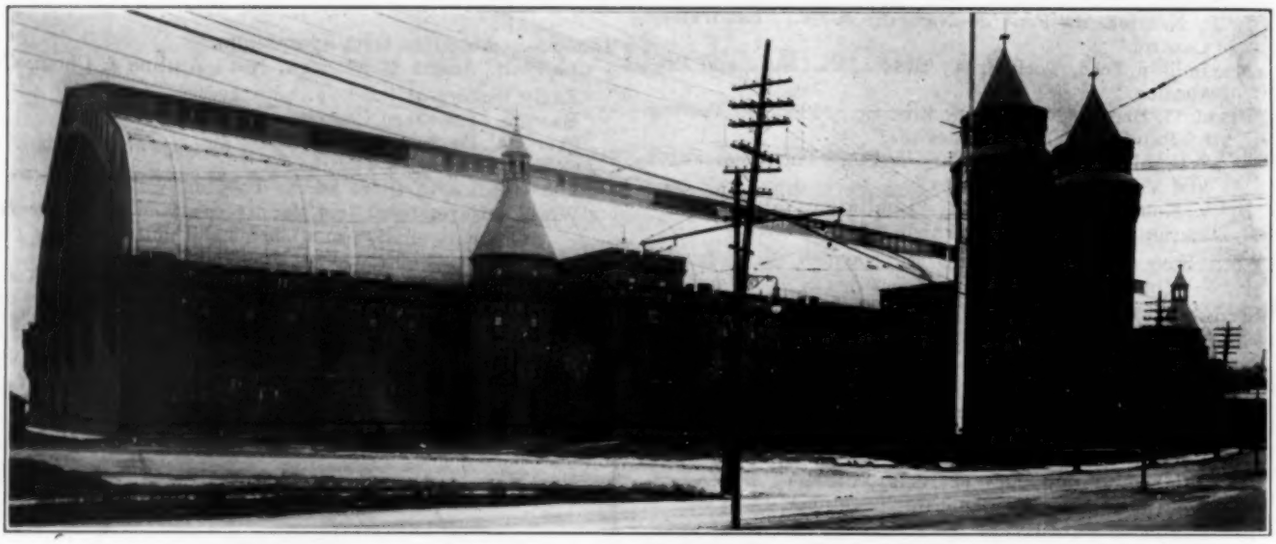
2:30 p.m. American Dyes Symposium.
Chairman, Justin B. Weddell, Nat'l Aniline & Chem. Co.
"Early History of the Dye Industry."
"Marvels of Modern Chemistry."
"Practical Dyeing Problems."
"Color Harmony in Textiles."
"The Relation of Color to the Theater."
"World Disarmament and the Necessity of an Independent American Dye and Chemical Industry."
"Is There an American Dye Monopoly?"

7 p.m. Motion pictures (subject to change).

1. "Manufacture of Newsprint Paper" (5 reels), courtesy Spanish River Pulp & Paper Mills.
2. "Making du Pont Dyes" (2 reels), courtesy du Pont Co.
3. "Manufacture of Dynamite" (1 reel), courtesy U.S.B.M.
4. "Mining Magnetic Iron Ore" (2 reels), U.S.B.M.



HOW TO GET THERE.



EIGHTH COAST ARTILLERY ARMORY, KINGSBRIDGE ROAD AND JEROME AVENUE

Exhibitors at the Exhibition

A Brief Catalogue of the Products and Equipment to Be Exhibited at the Seventh National Exposition of Chemical Industries, Together With the Names of the Four Hundred Exhibitors and the Representatives in Charge of Their Exhibits

THE following scientific societies and publications have reserved booths for the Seventh National Exposition of Chemical Industries, where they will be glad to receive their friends.

AMERICAN CERAMIC SOCIETY.
AMERICAN CHEMICAL SOCIETY.
AMERICAN DYESTUFF REPORTER.
AMERICAN PERFUMER AND ESSENTIAL OIL REVIEW.
CANADIAN CHEMISTRY AND METALLURGY.
CANADIAN MINING JOURNAL.
CHEMICAL AGE.
CANADIAN TEXTILE JOURNAL.
CHEMICAL CATALOG.
CHEMICAL COLOR AND OIL RECORD.
CHEMICAL & METALLURGICAL ENGINEERING.
COLOR TRADE JOURNAL.
COMBUSTION.
DRUG & CHEMICAL MARKETS.
INDUSTRIAL AND EDUCATIONAL PRESS.
IRON & STEEL OF CANADA.
JOURNAL OF COMMERCE.
JOURNAL OF INDUSTRIAL AND ENGINEERING CHEMISTRY.
MANUFACTURERS RECORD.
OIL, PAINT AND DRUG REPORTER.
PAPER MILL AND WOOD PULP NEWS.
PULP & PAPER MAGAZINE OF CANADA.
TEXTILE COLORIST.
TEXTILE WORLD JOURNAL.
TEXTILES.

The following list of exhibitors at the Exposition, together with a brief statement of their exhibits and the names of their representatives, will be of special value to those who expect to attend the Exposition. It is published well in advance in order to enable prospective visitors to conserve their time and to give their attention to those matters in which they are particularly interested. The list is practically complete. Where no description of exhibit is given, the information requested was not furnished or arrived too late for publication. No attempt has been made to give booth numbers or location in the Armory, because these will be more easily obtained from the handbook and guide which will be distributed at the Exposition with the compliments of CHEMICAL & METALLURGICAL ENGINEERING.

ABBÉ, PAUL O., INC.—Pulverizing, grinding, crushing, and cutting machinery. Represented by Henry Sellman and John Buckley.

ABBÉ ENGINEERING CO.—Grinding and pulverizing machinery. Represented by H. F. Kleinfeldt and A. T. Beach, Jr.

ABERNETHY, JOHN F.—Lead burning, lead-lined tanks, acid containers made of lead, lead condensing coils, and various other chemical equipment of lead. Represented by John F. Abernethy and John J. Kiernan.

ACID-PROOF CLAY PRODUCTS CO.—Acid-proof chemical stoneware, including storage vessels, tower sections, faucets and piping in the various designs. Represented by N. E. Hansen and J. E. Cooper.

AINSWORTH, WILLIAM, & SONS.—Analytical balances with improved rider and weight carriers of the latest types, and an assay balance with reflection reading device sensitive to 1/1000 mg. Represented by W. H. Smith.

ALBANY CHEMICAL CO.—Solvent specialties and pharmaceutical products. Represented by K. E. Schoeneman and Edward S. Wright.

ALBERENE STONE CO.—Standard fixtures and equipment for research and educational laboratories, including a complete line of Alberene stone chemical hoods, sinks, drain boards, table tops, gutters and reagent shelves. Represented by A. Y. Meeker, F. E. Healy, W. K. Fields, E. C. Collins, Wesley Heins, R. G. Grothe, F. R. Nichols and N. N. Moneypenny, Jr.

ALBERGER CHEMICAL MACHINERY CO., INC.

ALLIS-CHALMERS MFG. CO, INC.—Operating models of dust collector, pulverator, motor-driven bronze pump, rubber-lined pump, direct current and induction motors, and air compressors. Represented by A. F. Rolf, W. E. Keine, M. I. Dorfan, T. Pilger, H. W. Dennison, A. J. Cooper, F. J. Geiger, O. H. Hentz, W. C. MacEwen, C. H. Paine, George Baiz, W. O. Taylor and W. H. Wolf.

AMERICAN CHEMICAL & MFG CO.

AMERICAN COAL CHUTE CO.

AMERICAN CYANAMID CO.—Cyanamide, cyanide, liquid hydrocyanic acid, ferrocyanides, urea, dicyandiamide, am-

monia, ammonium phosphate, ammonium sulphate, ammonium nitrate, and nitric acid. Represented by E. J. Pranke, R. R. Stewart, F. S. Washburn, Jr., G. Thorn and A. E. Downes.

AMERICAN HARD RUBBER Co.—Chemical handling and conveyance equipment of hard rubber, including pumps, pipe fittings, tanks and utensils. Represented by A. M. Ackerman and D. W. Wilkins.

AMERICAN LAFRANCE FIRE ENGINE Co., INC.—Industrial safety devices, including the latest developments in breathing and eye protection for workers in chemical factories. Represented by James W. Knoblock, Arthur B. Crossman, R. C. Engels and J. E. Egan.

AMERICAN MANGANESE BRONZE Co. — The exhibit will show results of acid tests on various kinds of bronze castings and forgings used in the chemical trade, particularly those for centrifugals, valves and special castings made for sugar machinery. Represented by C. H. Spare, C. J. Bower and T. H. Addie.

AMERICAN METAL PRODUCTS Co.—A line of acid-resisting valves and fittings, rolled sheet and forged bronze, and bronze castings. Represented by C. J. Zaizer and A. S. Knowlton.

AMERICAN STEAM PUMP Co.

AMERICAN STEEL & WIRE Co.

AMERICAN WATER SOFTENER Co.—Model of pressure type filter and Decalso Zeolite type water softener; also a complete line of lime and soda water softeners. Represented by A. S. Garrett, W. T. Runcie, G. M. Graybill, J. B. Price and George F. Hodkinson.

ANACONDA COPPER MINING Co.—An exhibit to illustrate the smelting and refining of copper, starting with ore and following through the various processes to the refined article. The various valuable byproducts, metals and chemicals obtained in the electrolytic refining of copper are shown. Other features of the exhibit will show the various applications of copper, and display Anaconda white lead made by the electrolytic process, and Anaconda fertilizer, the treble superphosphate, containing 48 per cent P_2O_5. The products of the following subsidiaries will also be shown: Anaconda Lead Products Co., Anaconda Rolling Mills Dept., International Smelting Co., Raritan Copper Works and United Metals Selling Co. Represented by S. Skowronski and J. A. Dowdy.

ANGEL, H. REEVES, & Co.

ANTI-CORROSION ENGINEERING Co., INC.—Apparatus for treating water so as to make it non-corrosive to iron and steel pipe, tanks and other equipment. Represented by J. Wright Reeve and A. B. Christen.

ANTI-HYDRO WATERPROOFING Co.—Protective covering for concrete and cement masonry which is subject to direct contact with acids, alkalis, oils and various chemicals. Represented by B. A. Meyer, M. W. Meyer, Mrs. M. D. Hausling, T. Moore, W. C. Kober, C. A. Brown, M. E. Townsend and B. E. Lamphier.

APEX CHEMICAL Co., INC.—Industrial chemical products for the textile, leather and fur-dyeing industries and the manufacture of rubber, printing ink and allied products. Represented by S. M. Hermann, Hugo Helburn, Charles B. Rasenberger and Herman Rothstein.

ARKELL SAFETY BAG Co.—Elastic paper linings for barrels, bags, boxes and drums. Represented by P. J. Morales.

ARMSTRONG CORK Co.—Insulating brick to prevent loss of heat from furnaces, ovens, boiler settings, kilns and other high-temperature equipment; insulation covering for high-pressure and superheated steam lines, tanks, feed-water heaters, evaporators, electrically-heated ovens and hot surfaces; and cork coverings for brine and ammonia lines, cold-storage rooms and other installations where low and constant temperatures are required. Represented by S. L. Barnes.

ARNOLD, HOFFMAN & Co., INC.—Oils, water softeners, gums, starches, dextrines, pigment colors, caustic soda and liquid chlorine. Represented by H. H. Hall, W. R. Metcalfe, C. L. Berntson, G. D. Curtis, H. P. Geier and E. Siedenburg.

ATLANTIC ENGINEERING Co.

ATLAS ELECTRIC DEVICES Co., INC.—Apparatus for testing colored, printed and dyed material against the fading action of sunlight. Represented by C. W. Jameson and H. S. Thayer.

ATOMIZED PRODUCTS CORPORATION.

AVERY ROCK SALT MINING Co.

BACHMEIER & Co., INC—Applications and methods for the practical uses of dyes, including the exhibit of a new wood pulp paper card, and silk, leather, acid and chrome woolen sample cards. Represented by W. C. Baur, H. A. Tourrelle, William Lindemann, Henry J. Repp, G. Marston Lord and Henry Gettler.

BAHNSON Co., THE.

BAILEY METER Co.—Various types of Bailey fluid meters for measuring steam, water, gases and chemicals; V-notch weir meters having capacity of 60,000 lb. per. hr.; specific gravity recorders, draft gages and a differential gas pressure recorder accurate to 1/10,000 in. of water. Represented by E. G. Bailey.

BAKER & Co., INC.—Platinum laboratory ware and apparatus for chemical purposes; platinum, gold and silver and other precious metals. Represented by E. H. Pelletreau, H. Klausmann and Harold Whitehead.

BAKER, J. T., CHEMICAL Co.—Exhibit of "Baker's Analyzed Chemicals." Represented by W. P. Fitzgerald.

BAKER, JOSEPH, SONS & PERKINS Co., INC.—Laboratory and commercial mixing machines for dry powder and liquid work. Represented by A. Vollrath, J. C. Caley and S. D. Gridley.

BARBER ASPHALT PAVING Co.—Acid-proofing qualities of mastic flooring and exhibits of native lake asphalts and compounds. Represented by F. F. Massey, Theodore Thomas, C. N. Forrest, J. S. Miller, J. A. Topping, H. C. Hottel and F. J. O'Neill.

BARRETT Co., THE.—This company's exhibit will form a part of the general exhibit of the Allied Chemical & Dye Corporation.

BAUSCH & LOMB OPTICAL Co.—Chemical, metallurgical and binocular microscopes, metallographic equipment, optical measuring instruments, including colorimeters, refractometers and saccharimeters. Represented by C. L. Oswald and E. H. Anthes.

BEACH-RUSS Co.—High vacuum pumps, heavy liquid pumps, acid pumps, rotary air compressors and gas boosters. Represented by H. C. Russ and C. A. Beach.

BECKER, A. J.—Special types of carboy carriers and wooden carboy packages. Represented by Messrs. Becker, Barnes, Chuster and Boon.

BECKER, CHRISTIAN, INC.—Analytical chainomatic balances, specific gravity chainomatic balances, bullion and torsion scales. Represented by W. C. Symington, A. T. Millroy, J. W. Wetz, J. K. Dunn and S. W. Hess.

BECKLEY PERFORATING Co.—Perforated metals, welded tanks, sheet metal work, perforated monel metal agitator and coil tanks and monel metal varnish kettles. Represented by F. P. Huston, T. R. Harvey and T. P. Carlson.

BELLE ALKALI Co.—This company's products are exhibited in the booth of Arnold, Hoffman & Co., Inc.

BETHLEHEM FOUNDRY & MACHINE Co.—Chemical apparatus such as sulphonators, autoclaves, nitrators, etc., made of special non-corrosive iron. Represented by Robert E. Wilbur, J. George Lehman, A. H. Stevens, R. H. Stevens, A. O. Hartley, George Ettele, S. O. Solt, C. E. Volkhardt and R. W. Fluck.

BLACKMER ROTARY PUMP Co.—Various types of solid and lined rotary pumps. Represented by A. L. Rock and F. F. Goertz.

BLACKISTON'S SON, P., & Co.—Publications on chemistry and allied sciences. Represented by Walter B. Hilt.

BLAW-KNOX Co.—Forge and hammer welding process for the manufacture of homogeneous steel-plate vessels, clam-shell buckets for rehandling material and for excavating, etc. Also a general line of furnace appliances, sectional steel buildings and materials for general construction. Represented by William C. Coffin and D. C. Grove.

BOYER, KIENLE Co., INC.—A complete line of seed and nut oils, together with byproducts. Represented by J. R. C. Boyer and Charles F. Kienle, Jr.

BRISTOL Co., THE—Recording instruments, including pressure and vacuum gages, liquid level gages, thermometers, pyrometers, psychrometers, voltmeters, millivoltmeters, ammeters, shunt ammeters, wattmeters, frequency meters, electrical and mechanical time recorders, etc. Represented by H. L. Griggs.

BRITISH AMERICAN NICKEL CORPORATION, LTD.

BROWN INSTRUMENT Co.—High- and low-temperature measuring instruments, including indicating and recording pyrometers, recording thermometers, resistance thermometers, indicating and recording instruments for pressure, vacuum, time and operation. Represented by J. P. Goheen, G. W. Keller, J. D. Andrews, George Goodman, M. J. Hess, S. G. Ketterer, V. VanVliet and M. H. Leister.

BUCKMAN & PRITCHARD, INC.—Commercial articles made from zirconium silicate, including refractory bricks, cupola blocks, various sized crucibles, spark plug porcelains, high-tension insulators, electric heater units, pyrometer protection tubes and chemical ware. Represented by H. H. Buckman and G. A. Pritchard.

BUFFALO FOUNDRY & MACHINE Co.—A full line of vacuum driers, evaporators, chemical apparatus, sugar apparatus,

etc., showing new developments in Buflovak and Buflokast apparatus. Represented by E. G. Rippel.

BUILDERS IRON FOUNDRY.—Exhibiting a standard Venturi meter outfit consisting of a small Venturi meter tube on discharge from a motor-operated rotary pump; also registering devices and indicating recorders. Represented by C. G. Richardson and D. J. Purdie.

BURRELL TECHNICAL SUPPLY CO.—See exhibit of Mine Safety Appliances Co.

CALCO CHEMICAL CO.

CANADIAN PACIFIC RAILWAY CO.—Exhibiting a colored map showing the industrial resources of Canada.

CARBORUNDUM CO., THE.—Carborundum refractories consisting of brick, tile and shapes, muffles, saggers, etc., made of Carbofrax. Also carborundum refractory cements and a new refractory material which will be known as "Zirfrax." A complete line of abrasive products, consisting of grain, wheels, paper and cloth, rubbing stones, hones, etc., will be exhibited. Represented by C. E. Hawke, C. F. Geiger, S. A. Fenno, J. H. Harriott, W. L. Meek, F. J. Harrington.

CARBROX CO., INC. — An exhibit of carbrox, a vegetable decolorizing carbon used as a substitute for bone black in a great variety of industries. Represented by H. M. Shilstone and O. L. Barnebey.

CARRIER ENGINEERING CORPORATION. — Air-conditioning equipment, including complete automatic temperature and humidity control. Represented by J. E. Bolling, R. T. Tree, A. E. Stacey, Jr., and R. H. Ward.

CASH, A. W., CO. — Exhibiting section models showing internal construction and operation of the company's pressure reducing and regulating valves. Also other steam appliances such as pump governors, fan engine regulators, strainers and relief valves. Represented by Paulsen Spence, R. H. Keith and R. C. Cory.

CELITE PRODUCTS CO.

CENTRAL SCIENTIFIC CO.—DeKhotinsky constant temperature appliances, oil- and fuel-testing instruments, high-vacuum pumps, electrical appliances for the laboratory and various analyzed chemicals. Represented by O. T. Louis and S. L. Redman.

CHADWICK-BOSTON LEAD CO.

CHAPMAN ENGINEERING CO.

CHAPMAN STEIN FURNACE CO.

CHARLESTON INDUSTRIAL CORPORATION.—Exhibits showing the advantages of the City of Nitro, W. Va., as a location for chemical manufacturing plants. Represented by J. C. Hutsinpillar, R. J. O'Brien, M. F. Chase, W. H. Campbell and H. G. Scott.

CHEMICAL COMPANY OF AMERICA.

CHEMICAL EQUIPMENT CO. — Ceco acid-resisting valves, pumps and sprays, vacuum evaporators and tank car unloading systems. Represented by Robert V. Cook, R. T. White, Arthur Wright and C. A. Murphy.

CHEMICAL PUMP & VALVE CO.—Packingless centrifugal pump and valves, and other equipment for chemical manufacture. Represented by A. B. Antisell and F. A. Warter and others.

CHIRIS, ANTOINE, CO.—Synthetic aromatic chemicals, essential oils and perfume and flavoring materials of domestic and exotic origin. Represented by men from the sales department and technical staff.

CLEVELAND-CLIFFS IRON CO.—Photographic views of various manufacturing departments, also samples of various chemical products. Represented by Charles B. Hall, Austin Farrell and E. J. Hudson.

CLIPPER BELT LACER CO.—Three different types of belt lacing machines will be exhibited and also the application of the different sizes of belt hooks to all kinds of belting. Represented by William F. Kall.

COLTON, ARTHUR, CO.—Machinery for pharmaceutical manufacturers. Represented by R. L. Colton, F. X. Roellinger and B. W. Scott.

COMMERCIAL SOLVENTS CORPORATION.—Butanol, acetone and denatured alcohol and the products in which they are used. Represented by P. G. Mumford, H. E. Hall, C. L. Gabriel, Charles Bogin and T. F. Carty.

CONTACT PROCESS CO.—Sulphuric, muriatic and nitric acids, fuming sulphuric acid, oleum, mixed acid and salt cake. Represented by H. von Rucker and J. E. Curry.

CONTAINER CLUB.—Will display corrugated and solid fiber shipping boxes used for packing and shipping, etc. There is also to be demonstrated a device known as the Webb paper and box tester which is used in determining the strength of the board used in the manufacture of the boxes. Represented by J. D. Malcolmson and J. M. Webb.

COOPER HEWITT ELECTRIC CO.—An interesting display of mercury vapor arc lamps, the commercial source of ultraviolet light, will be shown to illustrate the various applications of the Cooper Hewitt Uviarc lamps. These will include photo-chemical appliances, therapeutic apparatus, water-sterilizing equipment, color-testing instruments and outfits especially designed as a source of monochromatic light for polariscopic, spectroscopic and interferometer work. Represented by L. J. Buttloph and M. B. Firehock.

COORS PORCELAIN CO.—Chemical and scientific porcelain for use in the laboratory control of practically all manufacturing operations. Also porous porcelain mass electrolytic cells. Represented by H. F. Coors.

CORNING GLASS WORKS.—A full line of Pyrex laboratory glassware. A number of experienced glass blowers will be at work making such pieces of laboratory apparatus as is possible under the conditions imposed. Represented by I. B. Cary, K. Kraissl, A. S. Eggleton, F. F. Pfeiffer and G. W. Drake.

CRANE CO.—A full line of pipe, fittings, valves, etc., in iron, steel and brass, and as a specialty their Cranefilt traps and pressure-regulating valves. A motor-operated gate valve will also be among the working exhibits. Represented by W. L. Osweld, William Sink, W. L. Whyte and J. F. Lee.

CRANE PACKING CO.—John Crane metallic packings for steam, air, oil, water and various chemical services, such as the handling of dilute or concentrated sulphuric acid, benzene, acidulated benzene, caustic soda solution, etc., Represented by Julian N. Walton, F. E. Payne and Miss Betty D'Vorin.

DAVISON CHEMICAL CO.—Exhibiting the various grades of sulphuric acid, 16 per cent to 18 per cent acid phosphate, concentrated acid phosphate, magnesium fluosilicate, precipitated silica, pyrites cinder, sintered ore and silica gel. A silica gel absorber and activator will also be in operation, showing the absorbent qualities of this material. In addition there will be a working exhibit of catalytic gel for the conversion of SO_2 to SO_3. Represented by C. Wilbur Miller, E. B. Miller, W. D. Huntington, J. R. Wilson, A. E. Marshall, W. A. Patrick, B. F. Lovelace, E. C. Holden, P. A. Davis, G. E. C. Connolly, J. B. Thomas, F. E. Wagner and A. Harvitt.

DAVIDSON, M. T., CO.—Pumping engines, condensers, evaporators, etc., used in chemical and allied lines. Represented by John Lowe, William E. Brennan, F. O. Kompass and Thomas J. Rogers.

DE LAVAL SEPARATOR CO.—A special feature will be the exhibit showing the De Laval method of refining cottonseed oil and also of brightning stock manufacture in the petroleum industry. General types of equipment for chemical and manufacturing projects will also be exhibited. Represented by Walter D. Cleary, A. F. Meston, John H. Lisle and Robert Kostelak.

DEPARTMENT OF MINES OF CANADA.—Economic minerals and ores found in Canada, together with some of the more important products manufactured from them. Represented by Robert A. A. Johnston.

DETROIT CHEMICAL WORKS.

DETROIT RANGE BOILER & STEEL BARRELL CO.—A display of "Perfect" metal bilge barrels of the closed type and with full removable heads. There will also be samples of both light and heavy drums and the new friction top Detroit light drum. Represented by W. B. Goddard and C. C. Choate.

DEVINE CO., J. P.—Illustrations of installations of several different types of apparatus, including a large quadruple effect vacuum evaporator having 26,000 sq.ft. of heating surface, a complete installation of a vacuum chamber drier with material being dried on the trays, and complete with the auxiliaries—i. e., surface condensers and dry vacuum pump. Represented by J. P. Devine, L. W. Graves, H. W. How and A. N. Howes.

DIAMOND STATE FIBRE CO.—A full line of vulcanized fiber sheets, rods and tubes, and also a new waterproof insulation, Condensite Celoron. Represented by Charles M. Bogert and E. J. Sniffen.

DINGS MAGNETIC SEPARATOR CO.—Exhibiting the laboratory apparatus known as the Magnetic Tube Analyzer, which is used for determining the amount of magnetic material in any substance which is concentrated magnetically. Represented by A. H. Ackermann, J. E. Randall, E. F. Oates and R. A. Manegold.

DISTILLATION INDUSTRIES, INC.—Exhibiting a demonstration of the Whitaker-Pritchard process of destructive distillation applied to the manufacture of illuminating gas.

DOMINION BUREAU OF STATISTICS. — Statistical charts showing the development in Canada of the chemical and metallurgical industries. Represented by S. J. Cook.

DOMINION WATER POWER AND FORESTRY BRANCHES, DEPARTMENT OF THE INTERIOR, CANADA.—Exhibit showing the

water-power and forest resources of the Dominion of Canada. Represented by W. B. Stokes.

DORR, CO., THE.—Exhibiting working models of the Dorr thickener, classifier, agitator and pumps manufactured by the company. The sewage clarifier and screen for the mechanical screening of municipal sewage and trade wastes will be shown, also a cane sugar juice clarifier and various other pieces of equipment and processes controlled by the company. Represented by G. W. Repetti, Frank Bachmann and F. A. Downes.

DOW CHEMICAL CO.

DRAPER MFG. CO.

DRYING SYSTEMS, INC.—Spray drying equipment for drying of liquids such as chemicals, milk and food products. Represented by F. A. Lippert and C. H. Currier.

DU PONT, E. I., DE NEMOURS & CO.

DURIRON CO.—Centrifugal and reciprocating pumps, exhaust fans, kettles, valves, cocks, pipe and fittings, laboratory apparatus and various other equipment designed to carry corrosive materials. Represented by M. W. Smith, W. E. Pratt, R. H. B. Elkins, E. A. Suverkrop and T. Jabine.

EAGLE-PICHER LEAD CO.—Lead pigments, lead pipe, lead castings and other specialties; lithopone, zinc oxide, slab zinc and model sublimed white lead plant will also be exhibited. Represented by J. R. MacGregor, H. Gates, C. E. Gilson, W. Van Berlo, H. B. Taylor and D. T. Eastman.

EAST JERSEY PIPE CO.—Hercules-Electric hydro extractors and electric extractors. Represented by H. H. Stephens and J. L. Haring.

ECONOMIC MACHINERY CO.

ECONOMY ENGINEERING CO.—Standard and specially designed portable elevators, tiering machinery, barrel storage racks, etc. A feature will be the recently developed hand-electric portable elevator or tiering machine. Represented by T. R. Tordoff, T. A. Duffey and L. H. Liebel.

EDGAR BROS. CO.

EGYPTIAN LACQUER MFG. CO.—Various articles upon which lacquer and lacquer enamels have been used to produce or preserve the finish. Represented by Charles Schlott, Frank G. Drake, C. E. Hayward and B. Popper.

EIMER & AMEND.—Bingham & Green viscometer and plastometer, Brooks rotating autoclave, calorimeter accessories, E. & A., A. D. L. and Whatman filter papers, mercury sealed stopcocks, electric titration apparatus, Fisher thermometer, Fleming and Fisher combustion bulbs, Freas ovens, balances, hot water mixers and water stills, Gramercy reagent bottles, Hortvet cryoscope, hydrogen-ion apparatus, MacMichael viscosimeter, microscopes, refractometers, colorimeters, Pickel extraction apparatus, replaceable unit furnaces and hot plates, and U. S. Navy emulsifier. Represented by Theodore Taistra, assisted by Messrs. Grille, Fisher, Chalfont, Banner, Churchill, Shulenberger, Eimer and Amend.

ELECTRO BLEACHING GAS CO.—Exhibit of liquid chlorine and of textiles and pulp bleached with this product. Represented by S. W. Jacobs, James B. Duggan, G. R. Ellis, W. J. Weed, W. A. Kennedy and D. K. Bartlett.

ELECTRO CHEMICAL SUPPLY & ENGINEERING CO.

ELECTROLYTIC ZINC CO.

ELMORE, G. H.—Continuous centrifugal driers, acid-resisting centrifugal pumps and various equipment for ore dressing and coal washing. Represented by R. C. Comley.

ELYRIA ENAMELED PRODUCTS CO.—Glass-enameled cast-iron apparatus for chemical manufacturing purposes. A complete glass-lined still set up with a hot oil circulation system for high-temperature work will also be exhibited. Represented by W. E. Gray, Jr., R. W. Smith, D. B. Etters, S. A. Smith, W. I. L. Duncan, E. P. Poste and M. Donauer.

EMPIRE LABORATORY SUPPLY CO.

ENGELHARD, CHARLES, INC.—Le Chatelier pyrometers, electric resistance thermometers, Unicurve base metal couples, automatic temperature and pressure controllers, Impervite porcelains and electric furnaces. Represented by C. W. Hubbard and D. S. Bessemer.

EVERLASTING VALVE CO.—Various types of valves for special valve service. Represented by E. N. Corning, S. E. Carman, D. A. Jenkins and F. S. Schultz.

FEDERAL PHOSPHORUS CO.

FLEISHER & CO., W. L., INC.—Exhibiting a spray drier in operation, with samples of various materials which have been spray dried; also air-conditioning apparatus. Represented by W. L. Fleisher, A. W. Lissauer, R. E. Keyes, D. L. Connelly and S. W. Fletcher.

FLETCHER WORKS, INC.

FLORASYNTH LABORATORIES.

FOUNDATION OVEN CORPORATION.

FOXBORO CO., INC.—Indicating and recording instruments such as thermometers, gages, carbon dioxide recorders, liquid level gages and temperature controllers. Represented by W. W. Patrick and Clarence Fuller.

FREEPORT SULPHUR CO.

FUEL PRODUCTS CORPORATION.

GARRIGUES, INC.

GEIGY CO., INC.

GENERAL BAKELITE CO.—Bakelite raw materials and the following finished products made from them: Agitators, airplane propellers, beads, bowling, billiard and pool balls, bushings, camera frames, dental lamps, distributor heads, electric drill parts, fire extinguishers, gears and pinions, impregnated fibers, instrument tops and handles, insulators, jewelry, knife-handles, oil-test cups, ornaments, pipe stems, pistol grips, switch blocks, telephone instruments, water ozonator parts, welding goggles, wire insulation and wireless apparatus.

GENERAL CERAMICS CO.—A complete line of chemical stoneware, standard shapes and forms of fused silica, and a display of magnesia ware. Represented by P. C. Kingsbury, Hubert Royer, K. J. Peters, J. F. Curran, R. S. Beecher and Lucy Walters.

GENERAL CHEMICAL CO.—This company's products will be exhibited in one of the booths constituting the Allied Chemical & Dye Corporation's exhibit. Baker and Adamson laboratory chemicals and the Herreshoff roaster furnace will be shown. Represented by G. G. Ackerson, J. M. Keating, G. N. Vardy, J. E. Wilson, W. J. Kramer and W. R. Chappell.

GENERAL ELECTRIC CO.—The features of the exhibit will be an automatic arc welding outfit and a 50-lb. brass-melting furnace. Furnace exhibit will comprise a semi-cylindrical furnace, a small toolroom muffled arc furnace used for treating tool steel, etc., in the shop, a soldering iron furnace for medium and heavy duty irons, and an automatic control board for a single electrode furnace for sixty-cycle, 230-volt operation. Represented by L. W. Shugg.

GENERAL FILTRATION CO., INC.—Exhibiting Filtros acid-proof artificial stone filter plates in various shapes and grades and in models showing commercial installations; also exhibiting Electro-Filtros, the acid-proof diaphragm. Represented by F. E. Leiby and W. W. Robacher.

GEORGIA LEAD WORKS.

GIBSON & PRICE CO.—This company's exhibit is a part of that of the United Lead Co.

GLAMORGAN PIPE & FOUNDRY CO.—The exhibit will consist of the following apparatus: A standard direct-motor-driven nine-compartment rotary vacuum filter, a standard duplex direct-motor-driven vacuum pump, a 3-in. high-frequency turbine pump, direct-motor-driven, a standard direct-motor-driven caustic flaker, and a working model of a continuous discharge gas-fired vertical limekiln. Represented by C. H. Hinnant.

GLENS FALLS MACHINE WORKS.—Iron, brass and bronze foundry, paper and pulp machinery. A feature of the exhibit will be the rotary sulphur burner. Represented by O. J. Mills and Frederic S. Chaffee.

GOULDS MANUFACTURING CO.—Exhibiting a line of reciprocating, centrifugal and rotary pumps. Represented by H. R. Gumbert, H. J. Angell, W. J. O'Neill and E. E. Brereton.

GRAVER CORPORATION—Exhibiting models of water-softening equipment, water-filtering equipment and photographs of acid, chemical and oil storage tanks; also other installations of special steel plate work. Represented by K. W. Bartlett and John J. Felsecker.

GRINNELL CO., THE.

GRINNELL CO., DRYER DIVISION.

HANOVIA CHEMICAL & MANUFACTURING CO.—Quartz glass laboratory wares, special apparatus of quartz glass for laboratory processes, electric resistance furnaces for laboratory use, mercury-vapor arc lamps for various chemical processes—e.g., bleaching, dyeing and testing of colors, oils, etc., Laboratory thermometers with platinum spiral inclosed in quartz glass. Represented by F. W. Robinson, J. P. Rainbault, A. L. Schweickart, C. C. Minter, J. W. Kolbert and E. Simmonds.

HARDINGE CO.—Conical ball and pebble mills as used for crushing, grinding and pulverizing will be shown with the accessory parts neecssary for different classes of operation. The application to chemical industrial and metallurgical processes will be illustrated. A feature of the exhibit will be a full working size mill set up completely and equipped with all necessary accessories including chain drive and electric motor. Represented by William H. Baker, H. W. Hardinge, Harlowe Hardinge, R. B. T. Kiliani, V. A. Stout, Robert S. Schultz, Jr., G. F. Metz, Alden Crankshaw and James G. Parmelee.

HAUSER-STANDER TANK CO.—Exhibiting a cylindrical

shaped agitator tank designed especially for chemical use; also a rubber-lined cylindrical tank for the storage of muriatic acid. Other equipment of interest to users of wooden tanks will also be exhibited. Represented by S. Hauser, Jr.

HAYNES STELLITE CO.

HAYS, JOSEPH W., CORPORATION.—Exhibiting various forms of combustion efficiency apparatus such as draft and pressure gages, gas analyzers for flue gas analysis and other special purposes, automatic carbon dioxide and draft recorders and a new float-type recording draft gage for ranges below 3 in. W.

HEPWORTH, S. S. CO.

HERCULES ENGINEERING CORPORATION.

HEYDEN CHEMICAL CO.

HOOKER ELECTROCHEMICAL CO.—An exhibit of the various chemicals that can be manufactured electrolytically from salt, with various samples of caustic soda, bleaching powder and liquid chlorine. Represented by W. H. Chamberlain, B. K. Hotchkiss, G. F. Reale and W. J. Smith.

HUFF ELECTROSTATIC SEPARATOR CO.—Exhibiting a Huff electrostatic separator showing the purification of rock salt, mica, feldspar and fluorite; also a Plumb pneumatic jig for concentrating various ores. Represented by H. B. Johnson, F. R. Johnson and William E. McKee.

HUNGERFORD, U. T., BRASS & COPPER CO.

HUNTER DRY KILN CO.—Exhibiting a model of the Hunter drying system which illustrates the principle of utilizing humidity in connection with drying. Represented by Harry Hunter, O. M. Ragsdale and A. B. Stonex.

HUYCK, F. C., & SONS.—Operating the Kenwood Mills. Exhibiting Kenwood all-wool filter cloth. Represented by E. A. Rees and G. L. Gundel.

HUYETTE, PAUL B., CO., INC.

ILLINOIS ZINC CO.

INDUSTRIAL FILTRATION CORPORATION.—Exhibiting a continuous rotary filter in operation with the necessary tanks and pumps, a small-size continuous rotary hopper dewaterer, and a model of the open-tank type of filter. Represented by William H. Harding, George D. Dickey and Harry W. Conrad.

INNIS, SPEIDEN & CO., INC.—Will exhibit a complete line of industrial chemicals, including photographic chemicals, dye intermediates, talc, casein and milk products and various heavy and fine chemicals of domestic and foreign origin. Represented by E. H. Manahan, H. G. Mackelcan and C. L. Speiden.

INTERNATIONAL CARBON PRODUCTS CO.—Graphite products, the crude ore, from which domestic flake is manufactured into products suitable for crucibles, foundry facings, paints, pencils, batteries, electrodes, water compounds and packing. Represented by H. B. Johnson and Charles D. Burrage, Jr.

INTERNATIONAL COOPERAGE CO., INC.—Exhibiting a complete line of tongued, grooved and plain barrels, such as are particularly adapted to the shipment of dry chemicals, lime, plaster, cement, paste and plastic materials. Represented by B. E. Cuthbert and E. H. Kattman.

INTERNATIONAL NICKEL CO.—Various forms of monel metal partly and completely fabricated with particular attention to its application in the chemical industry. Represented by G. A. Wotherspoon and E. A. Turner.

INTERNATIONAL SALT CO. OF NEW YORK.—Exhibiting various kinds of salt used for chemical purposes. Represented by W. T. Chisholm, George A. Walter and H. J. Osborn.

INTERNATIONAL SMELTING CO.—See exhibit of Anaconda Copper Mining Co.

IRVING IRON WORKS CO.—Exhibiting metallic fireproof ventilating flooring and steps. Represented by Walter E. Irving, Paul Leon Price, W. H. Roope, H. H. Schuldt, J. M. Madden and H. H. Bunker.

ISKO BAUTZ CO., INC.—A display of water floated silica and soft silica of various grinding and consistencies.

ISKO CHEMICAL CO., INC.—Caustic soda and chloride of lime. This company's products and those of the preceding company are exhibited by Innis, Speiden & Co., Inc.

JEWELL POLAR CO.—A display of water-distilling equipment of laboratory and industrial types. Represented by A. C. Jewell, J. H. Needler, R. E. Henry and C. Munson.

K-B PULVERIZER CO., INC.—Exhibiting Pulverburner, a coal-pulverizing and burning equipment and a standard K-B hammer mill. Represented by A. J. Barnebl, Jr., E. H. Brown and J. K. Blum.

KELLOGG, THE M. W. CO.—Exhibiting high-pressure autoclaves, direct-fired kettles and various other chemical equipment manufactured from Kellogg forge-welded steel "Chemi-Steel." Represented by H. Le Roy Whitney.

KENART SYNTHETIC PRODUCTS CO.

KENNEDY VALVE MFG. CO.

KEWAUNEE MFG. CO.

KIEFER, KARL, MACHINE CO.—Exhibiting bottle-rising, filling and corking machines, filling and packaging equipment, filters and pumps. Represented by E. E. Finch, A. J. Sterling and Matt C. Finn.

KLIPSTEIN, A., & CO.—A display of industrial chemicals, colors, dyestuffs, varnish colors, tanning materials, oils and waxes. Represented by A. Klipstein, Jr.

KNIGHT, MAURICE A.—Exhibiting acid-proof chemical stoneware of all shapes and sizes. Represented by Maurice A. Knight, Charles Dennison, Samuel J. Baril, G. Gordon Urquhart and Percy Sawyer.

KOPPERS CO., THE.—Exhibiting a miniature model of a battery of byproduct coke ovens and of various improved types of gas governors and continuous tar stills. Represented by Charles R. Meissner and D. E. Price.

KOPPERS PRODUCTS CO.

KOVEN, L. O. & BRO.

LAKE ERIE CHEMICAL WORKS of the General Electric Co.—Exhibiting tungstic acid, sodium tungstate, tungsten metal powder, mango powder (iron manganese oxide), opaque glass enamel and finish. Represented by W. S. Murtfeldt.

LAMIE CHEMICAL CO.

LEAD-LINED IRON PIPE CO.—Exhibiting lead-lined iron pipe, fittings, valves, stop cocks and block-tin-lined iron pipe and fittings. Represented by Daniel H. Regan, Harry F. Peck, Thomas E. Dwyer and Joseph C. Huestis.

LEEDS & NORTHRUP CO.—The exhibit comprises pyrometers of the potentiometer type, indicating, recording, signaling and controlling, and electrical instruments for the determination of the chemical conditions of solutions by the measurement of electrolytic conductivity of hydrogen-ion concentration. Represented by O. Brewer, C. R. Cary, E. H. Day, G. H. English, E. B. Estabrook, E. A. Keeler, R. D. Milner, A. M. Redding, G. W. Tall and P. H. Taylor.

LEFRANC CHLOROZONE WORKS.—Exhibiting the Schwenk carboy tilter. Represented by L. W. Schwenk, V. E. Schwenk, R. F. Rutledge and W. P. Joerger.

LEWIS, GREEN, MCADAMS & KNOWLAND—Displaying a typical experimental drier such as has been successfully used for the solution of a number of drying problems. Represented by R. G. Knowland and John H. Holton.

LIBERTY BY-PRODUCTS WORKS, INC.—A display of various chemicals, soaps and oils. Represented by E. J. Zillessen, W. H. Zillessen, A. D. Washington and A. Naab, Jr.

LIQUID CARBONIC CO., THE—Displaying cylinders containing 99.9 per cent CO_2 connected to a 6-drum outfit, such as is used by many chemical industries. Represented by E. D. Hale, C. S. Wheaton and L. W. Greiner.

LITTLE, ARTHUR D., INC.—Exhibiting the following limited number of subjects as examples of this organization's work in the fields of chemistry, engineering and business management. A silk purse made from a sow's ear, a new plywood glue developed in their laboratory and now made under their technical supervision, single coat gray enamel ware produced for a leading manufacturer. "A. D. L." quantitative filter paper. Process exhibit, separation of zinc from complex ores, and a study of available economies in the fuel situation. Represented by Robert F. La Baron and Frank Farley.

LUNGMOTOR CO.—Exhibiting a simple resuscitating device for use in cases of gas or fume or smoke poisoning, or in apparent drowning or in electric shock collapse, etc. Represented by L. D. Jones and Max Jacobson.

LUNKENHEIMER CO., THE.—The display will consist of valves, boiler mountings, oil cups, grease cups, lubricators, oil pumps and similar products used in the engineering field. Valves constructed of bronze, nickel alloy, cast iron, Monel, electric furnace cast steel and special non-corrodible alloys adapted for the chemical industries will be shown.

LUZERNE RUBBER CO.—Exhibiting a general line of hard rubber articles, especially adapted for use in the handling of acids or corrosive liquids. Represented by H. E. Case.

MAAS & WALDSTEIN CO.—This company will have two exhibits, one of lacquer and lacquer enamels and the other of leather solutions with samples of lacquer and lacquer enamel, and wood and metal finished with these materials. Represented by H. C. Flanigan, C. Frey, G. J. Karl, W. S. Elwin, J. A. Weiss, S. L. Dickinson and H. E. Maynard.

MAGNA METAL CORPORATION.

MAGNESIA ASSOCIATION OF AMERICA.—Exhibiting samples of 85 per cent magnesia pipe and boiler covering, magnesia blocks and lagging for hot steam surfaces, magnesia plastic, and samples of carbonate of magnesia. Represented by C. J. Stover and G. S. Stuart.

MANHATTAN RUBBER MFG. CO.—Exhibiting hard-rubber-coated blowers and pipe and equipment, including a hard-rubber-coated centrifugal in operation. Also transmission belting, conveyor belting and rubber hose of all kinds. Rep-

resented by W. A. Pritchard, Harry Snyder, W. L. Sturtevant and others.

MANNING, MAXWELL & MOORE.

MATHIESON ALKALI WORKS.—Exhibiting soda ash, caustic soda, bleaching powder, liquid chlorine, bicarbonate of soda, sesquicarbonate of soda, and various chlorine solvents, such as tetrachloride, ethylene chloride, etc. Represented by John A. Kienle, John W. Boyer, B. T. Brooks, H. M. Mabey, J. H. McMahon, E. E. Routh, J. A. Rose, W. D. Marshall, R. J. Quinn, R. C. Staples, R. A. McMichael, L. R. Yancey, G. N. Davis and J. B. Peake.

MEAD & CO.—Grinding and pulverizing mills including the small sized Mead mill for laboratory and small production purposes. Represented by Paul O. Abbe, Inc.

MERCK & CO.—Exhibiting a general line of fine chemicals, particularly medicinals and pharmaceuticals. A feature of the exhibit this year will be the large number of useful salicylates, such as salicylic acid, sodium salicylate, methyl salicylate, phenyl salicylate, etc.

MERRILL CO., THE.—Exhibiting the Merco Nordstrom plug valve. Represented by H. P. MacGregor.

METALS DISINTEGRATING CO., INC.—The following products will be exhibited: Zinc dust, tin dust, lead dust, aluminum powder, magnesium powder, copper powder and nickel powder. Represented by S. G. Schatzberg, D. A. Morris, E. J. Hall and P. V. Dair.

MIDLAND CHEMICAL CO.

MINE SAFETY APPLIANCES CO.—Exhibiting different types of the Burrell industrial gas masks, such as are used by fire fighters, steel workers, operators of gas producers and in other industries where carbon monoxide is met. There will also be shown a simple device which indicates immediately the presence of carbon monoxide gas. Other safety equipment such as oxygen-breathing apparatus, electric lamps, gas indicators, first-aid outfits, steel signs, etc., will be shown. Represented by G. H. Burrell, J. L. Lehman and H. J. Segrave.

MINERAL POINT ZINC CO.

MOJONNIER BROS. CO.

MONARCH MANUFACTURING WORKS, INC.

MONO CORPORATION OF AMERICA.—Exhibiting automatic analytical and recording apparatus for the analysis of oxygen in hydrogen gas, hydrogen in oxygen gas, chlorine in chlorine gas, carbon monoxide in producer gas and sulphur dioxide for the sulphite industries. Represented by F. D. Harger and Albert Saunders.

MONEL METAL PRODUCTS CO.

MONSANTO CHEMICAL WORKS.

MORSE CHAIN CO.—Exhibiting a number of samples of different size chains, showing the Morse rocker joint, ranging in size from ⅜-in. pitch to 3-in. pitch and in several widths illustrating the chain as used for ¼ hp. to 5,000 hp. Represented by R. G. Anderson and various members of the sales staff.

MOTO METER CO., INC. — Exhibiting the Boyce Motometers, with particular emphasis on their application to industrial uses, such as the indication of temperature in chemical vats, tanks, ovens and drying rooms, coal piles, refrigerators, kettles and pasteurizers, etc. Represented by J. C. Elverson.

MOTT, THE J. L., IRON WORKS.—Exhibiting acid-resisting enameled cast-iron kettles, stills and autoclaves, and also furnaces suitable for their mounting. Represented by J. J. Blackmore, and T. H. Blackmore.

MULTI METAL CO—A display of wire cloth in brass, copper, bronze, Monel metal, steel and tin coated wires, also metallic filter cloth, a complete line of standard laboratory testing sieves, and samples of wire cloth ranging from No. 2 mesh up to No. 300 mesh. Represented by Siegfried Stern, Frederick Stern and S. Pullman.

NASH ENGINEERING CO.—Hytor air compressor and vacuum pump, Jennings return-line heating pump, drier exhaust unit, centrifugal pump and sump pump. Represented by Irving C. Jennings, R. H. Carpenter, H. M. Wylie and G. B. Wright.

NASSAU VALVE & PUMP CORPORATION.—Exhibiting the Chemetal acid-resisting valves and centrifugal pumps. Represented by A. T. Haviland, C. Schmitt, J. Figel and B. W. Dezotell.

NATIONAL ANILINE & CHEMICAL CO, INC.—The exhibit of this company will be especially artistic in design, and the decorative effects have been carefully considered in order to show the avenues of usefulness for this company's dyes. A feature of the exhibit will be a colorist's laboratory, in which dye testing will be done.

NATIONAL BINDING MACHINERY CO.

NATIONAL FILTER CLOTH & WEAVING CO.—Different styles and weaves of cotton filter cloth for various filter presses. Represented by M. W. Smith, E. Boffin, L. R. Prior, T. Moors and T. Dunn.

NATIONAL GUM & MICA CO.

NATIONAL LIME ASSOCIATION.—The association will exhibit a model of a lime plant, charts showing the operations in lime manufacture and the distribution of the uses of lime, together with various materials, such as glass, leather and lime stucco panels, which are made with the use of lime. Represented by M. E. Holmes.

NATIONAL RESEARCH COUNCIL.—An exhibit intended to show the necessity for fundamental chemical research, and the relation of organic chemistry to peace- and war-time industries. Represented by H. E. Howe, H. S. Kimberley and O. E. Roberts.

NATIONAL ROSIN OIL & SIZE CO—Exhibiting various grades of rosin oil and pitches such as are used in the manufacture of greases, printing inks, canvas belting, waxes, paper cables and brushes. Represented by Richard Bender.

NEWARK WIRE CLOTH CO.—A display of wire cloth of all grades, metallic filter cloth and testing sieves. Represented by A. A. Campbell, L. C. Campbell, J. C. Campbell and E. J. Korn.

NEW BRUNSWICK CHEMICAL CO.—Exhibiting a general line of textile soaps, sizings and finishes, also terpol hydrate, which is a special warpsizing made by this company.

NEW ENGLAND TANK & TOWER CO.—This exhibit will show a complete outfit, in operation, including tank, stirrer and direct-connected motor-driven agitator. Different types of stirring equipment and of apparatus for transporting semi-liquids and liquids will also be shown. Represented by Arthur E. Hall, George E. Hall, Conrad Pennucci and Warren O. Chace.

NEW METHOD UTILITIES CO.—Exhibiting photographs and working drawings of a refrigerating and ice-making system without moving parts, which has recently come into use in chemical plants. Represented by B. K. Nagel and H. A. Leeuw.

NEW JERSEY ZINC CO.—Besides exhibiting its entire line of zinc products, this company will feature Horse Head rolled zinc for building construction work. Zinc leaders, eaves-troughs, Spanish tiles, flashings, valleys, fittings, etc., installed on an improvised portion of roof, will be displayed. Other zinc products and byproducts will include zinc oxide, slab zinc. zinc dust, Albalith, lithopone, zinc sulphate, feathered zinc, salt cake, sulphuric acid, muriatic acid, and zinc chloride. Represented by W. H. Hendricks, A. E. Mervine, F. C. Ryan, S. C. Reynolds, F. W. Edwards, S. T. Ballinger, C. F. Beatty and H. W. Henderson.

NEWPORT CHEMICAL WORKS, INC.—The exhibit of this company will illustrate its slogan of "Coal to Dyestuff." Represented by Giles Low, J. S. Lange and C. F. Schaumann.

NEW YORK CENTRAL IRON WORKS CO., INC. — Exhibiting photographic views of steel tanks, stacks, breechings and chemical equipment of all kinds. Represented by Paul G. Koch, H. M. Olson, C. E. Plack and C. R. Rupp.

NEW YORK JEWELL FILTRATION CO.—Exhibiting the operation of the refiltration system which is applied in paper making and in other industries where the conservation of water is essential. Another feature of the exhibit is various types of chemical feeding devices which are used for regulating the dosage of chemicals in large filtration plants. Represented by A. L. Sollder, Arthur M. Crane, E. K. Sorenson and D. C. Williamson.

NIAGARA ELECTRO-CHEMICAL CO.

NICHOLS COPPER CO.—An exhibit to show the use of copper sulphate (as Bordeaux mixture) in the cultivating of fruit and vegetables; the use of red copper oxide in marine paints, and the production of copper wire and ingot bars, cakes, slabs and cathodes. Represented by G. P. Hitchcock.

NITROGEN CORPORATION.—Exhibiting various products of ammonia made by synthesis from atmospheric nitrogen. Represented by A. Nagelvoort and J. C. Clancy.

NORWALK IRON WORKS CO.—Exhibiting a new Norwalk vertical three-stage oxygen compressor and a multi-cylinder ammonia refrigerating compressor. Represented by A. R. Betts.

OBERMAYER, THE S., CO.—Hott-Patch furnace cement for power and chemical plants. A small electric furnace will be used for demonstration of the product. Represented by E. D. Frohman, F. P. Bullion, H. E. Beckman, J. M. Hildebrand and W. R. Cummings.

OLIVER CONTINUOUS FILTER CO.—Exhibiting a complete Oliver continuous and automatic filter in operation. Represented by H. A. Morrison, C. T. Eastman, C. W. Moore and L. W. Knapp.

PACIFIC COAST TALC CO.—This company's products will be exhibited with those of Innis, Speiden & Co.

PALO Co.—Exhibiting the following apparatus: Hess-Ives tint photometer, American-made spectroscopes and refractometers, Durieux filter paper, analytical balances, Meker burners and various types of furnaces, including those used for high-temperature crucible work and for fusion, heat-treating, annealing, etc. Represented by L. A. Pfluger, H. A. Peterson and M. J. Seavy.

PARKS-CRAMER Co.—Exhibiting a small-size standard Merrill process system such as is used for supplying heat by oil circulation. High-duty humidifier heads and a heat and humidity regulator will also be exhibited. Represented by Alexander B. McKechnie, Thayer Francis, Stuart H. Caldwell, J. W. F. Macdonald, A. W. Thompson and Frank G. Bell, Jr.

PENNSYLVANIA SALT MFG. CO.

PERMUTIT Co., THE.—A display of a model of the Zeolite water softening and filtration equipment manufactured by this company. Represented by A. T. Smith, R. W. Epple, J. S. Shedden and G. E. Boyd.

PERRY & WEBSTER, INC.

PERTH AMBOY CHEMICAL Co. See exhibit of Roessler & Hasslacher Chemical Co.

PFAUDLER Co., THE.—Exhibiting a glass-lined closed jacketed mixer (furnished with an enameled steel agitator) which is used in the manufacture of chemicals, dyes, printing inks, coal-tar products, etc. Other standard glass-lined equipment and accessories will also be exhibited. Represented by R. B. Kilmer, I. E. Colvin, J. A. Cowles, P. S. Barnes, F. J. Bresnan and T. D. Wilson.

PHILADELPHIA DRYING MACHINERY Co.—An exhibit of the various types of Hurricane drying machines, including the cabinet tray drier and truck tray drier. Also a photographic display of various installations. Represented by W. W. Sibson, C. H. Reumann, E. K. Moore and S. Watson.

PHILADELPHIA QUARTZ Co.—Liquid, solid and powdered forms of silicate of soda. Represented by R. C. Brown, W. H. Buxton and A. W. Moore.

PITTSBURGH-DES MOINES STEEL Co.—Exhibiting pictures and blue prints of various installations of structural steel work. Represented by Ivan A. Bickelhaupt.

PNEUMERCATOR Co., INC.—A display of a complete line of gages for the indication of depth, weight, volume or specific gravity of any liquid stored in tanks at any pressure. Represented by H. S. Parks and William Thomas.

POTDEVIN MACHINE Co.

POWER SPECIALTY Co.

POWHATTAN MINING Co.—Asbestos in its various stages of manufacture from the mining of the crude asbestos to the fabrication of the finished product will be exhibited. Represented by Fred A. and Frank Mett.

PRECISION INSTRUMENT Co.—Exhibiting a general line of boiler room and gas plant specialties, including the precision single and multiple indicating and recording gages, combustion recorders, orsats, gravitometer, calorgraphs, etc. Represented by L. D. Vorce, E. C. Rack, Robert Hooper and R. H. Tilghman.

PROCTOR & SCHWARTZ, INC.—Exhibiting a model of the Proctor driers for drying colors, chemicals, raw stock, soap, etc. Samples of all kinds of materials dried in Proctor driers will be exhibited and a projectiscope will show various installations in representative chemical plants. Represented by E. B. Ayres, H. S. Landell, D. D. Hollenbaugh, A. O. Hurxthal and Mrs. A. E. Reiter.

PROVOST ENGINEERING Co.

PYROELECTRIC INSTRUMENT Co.—Exhibiting a line of electrical precision instruments, including pyrometers and apparatus for hydrogen-ion determinations, both electrometrically and colorimetrically. Represented by W. C. Harter and Harry L. Saums.

QUIGLEY FURNACE SPECIALTIES Co.—Materials and equipment for furnace construction and operation, including a high-temperature cement for bonding fireclay and silica bricks and blocks, as well as granular refractories, a specially prepared cellular refractory brick used in insulating furnace structures for the conservation of heat, and a highly refractory fire sand used with a suitable binder for making rammed-in linings for furnaces, special tile, patches and repairs. The Quigley powdered coal system will also be demonstrated. Represented by W. S. Quigley, H. A. Kimber, J. H. McPadden, F. W. Reisman, W. H. Gaylord, Jr., W. A. Toohill and C. C. Gantzman.

RARITAN COPPER WORKS.—See exhibit of the Anaconda Copper Mining Co. for a description of products to be displayed by this company.

RAYMOND BROS. IMPACT PULVERIZER Co.—An exhibit of operating models showing the various types of pulverizers, roller mills and air-separating plants produced by this company. The machines will be in actual operation, grinding representative materials. Represented by C. M. Lauritzen, W. M. Cook, Joe Crites and S. B. Kanowitz.

RAYMOND LEAD WORKS.—Exhibit with the United Lead Co.

READ MACHINERY Co.—An exhibit of different types of mixers such as are used for mixing pharmaceutical products, pastes, polishes, food products, etc. Represented by D. D. Strite.

REFINITE Co., THE.

RELIANCE GAUGE COLUMN Co.

RHODIA CHEMICAL Co.

ROBERTSON, JAS., LEAD WORKS.

ROESSLER & HASSLACHER CHEMICAL Co.—Exhibiting a large number of chemicals applicable to electroplating, ceramics, mining, cleaning, bleaching, dyeing, oxidizing, paint manufacture, soap making, tanning, rubber industry, hydrogenation, refrigeration, steel tempering and case-hardening, electric cells, fireworks, fireproofing, etc., together with solvents, colors, rare metals, metal oxides, fumigators, insecticide and fungicide products. Represented by Sterling Temple, M. S. Stewart, T. V. Ainslie, F. Abegg and C. S. Williams.

ROTO Co., THE.—Exhibiting a line of tube-cleaning apparatus, which consists of specially designed motors operated by compressed air or steam, equipped with specially designed tools for the removal of deposits from the heating surfaces of tubular apparatus such as steam boilers, economizers, condensers, heaters and other apparatus of a similar character. Represented by W. R. Van Nortwick, W. M. Kelley and J. V. Doherty.

RUGGLES-COLES ENGINEERING Co.—Exhibiting models, photographs and drawings of the various types of driers manufactured by this company. Represented by F. E. Finch, W. H. Glomb and J. K. Towers.

SALMON FALLS MANUFACTURING Co.—A display of Toron-treated fabrics, together with samples of rubber products and insulators which have been manufactured by the use of Toron-treated fabrics. Represented by A. Russell Atwater and W. B. Pratt.

SANDOZ CHEMICAL WORKS, INC.

SANDUSKY COOPERAGE & LUMBER Co.—A complete line of barrels suitable for packing both dry and liquid chemicals. Represented by A. O. Theobold.

SARCO Co., INC.—Sarco temperature regulators for tank, room and kiln control. Sarco steam traps for low and high pressure. The new Sarco radiator trap Type "E" and the new Sarco (Fournier) indicating thermometers for chemical and industrial purposes. Represented by Clement Wells, E. J. Ritchie, G. H. Burke and G. F. Cordner.

SCHAEFFER & BUDENBERG.—A complete line of efficiency-promoting instruments, such as indicating and recording gages, indicating and recording thermometers, counters, tachometers, calorimeters, etc. Represented by Messrs. Undeutch, Campbell and Schipper.

SCHUTTE & KOERTING Co.—Complete line of power plant equipment, consisting of: Oil-burning, oil-heating and oil-cooling apparatus; feed-water heaters, injectors, condensers, stop check valves, trip throttle valves, reducing valves and engine stop valves; pump primers, undergrate blowers; also other Koerting steam, water, and air jet appliances, and the Schutte line of lead-lined and special duty valves, which are used in the chemical industry. Multi-jet condensers in operation under vacuum and also open for inspection. Schutte engine stop system with overspeed tripping device also in operation. Represented by Messrs. Kimberly, Gessleman, Philbrook and Keet.

SCHWARTZ SECTIONAL SYSTEM.—Sectional filing cabinets and auxiliary desks for chemical laboratories. Represented by M. P. Schwartz.

SCHWENCK CARBOY TILTER Co.—See Exhibit of Lefranc Chlorozone Works, Inc.

SCIENTIFIC EQUIPMENT Co.—As Eastern Sales Division of Central Scientific Co. and Kewaunee Mfg. Co., will exhibit a representative line of American-made laboratory furniture and apparatus. Represented by J. M. Roberts, S. L. Redman, A. B. Carter, Charles G. Campbell, O. T. Louis, Charles Ress, Edward Breitwieser, Joseph R. Fisher, Theodore Fuchs, Jr., and A. V. Hoveling.

SCOTT, ERNEST & Co.—Photographs showing a number of installations which have been furnished to various trades and are used for reclaiming chemicals of value from factory waste liquor, deposits, etc. The apparatus illustrated by the photographs will consist of: Vacuum evaporators as used by the soap trade for recovering glycerine from waste spent lyes, paper pulp mills for recovering the caustic alkali from waste black liquors, cotton finishers for recovering the caustic from waste mercerizing waters, glue and gelatine manufacturers for concentrating their liquors,

caustic soda manufacturers for concentrating caustic soda liquors, distilled water manufacturers for making pure water from sea, brackish and other waters, packing houses for concentrating tankage liquors, and many other uses; vacuum driers as used by food, paint, salt and other manufacturers; solvent extraction apparatus as used by oil manufacturers for extracting oils from seeds, beans, nuts, etc., also from waste filter press residues, grease from bones, oil from fish waste and other waste oily and greasy materials, such as sewage, wool scourings, packing-house tankage, etc.; ammonia stills for making pure ammonia; and wood-distillation plants. Represented by H. Austin, R. W. MacGregor and C. E. Bradley.

SEMET-SOLVAY CO.—Model of a Semet-Solvay byproduct coke oven, which is complete in every detail. A model illustrating the use of Solvay granulated calcium chloride as a natural dust layer and binder for roads, tennis courts, playgrounds, race tracks, etc. In addition a complete line of products manufactured by the company will also be displayed. Represented by E. C. Scott.

SEYDEL MFG. CO.—Samples of fifty or more benzoates together with literature covering their uses in the fields of medicine and of preserving foodstuffs. Furamine dyes, which are used for dyeing skins and furs. Represented by Edmund E. Smith.

SEYMOUR & PECK CO.—Wooden shipping drums which are used as shipping packages for aniline dyes, dry colors, insecticides and other dry chemicals. Represented by C. B. Arnold and Mrs. C. H. Bacon.

SHARPLES SPECIALTY CO.

SHEFFIELD BY-PRODUCTS CO.—This company's products will be exhibited with those of Innis, Speiden & Co.

SHERWIN-WILLIAMS CO., THE.—The manufacture of paints, varnishes, dyes, chemicals, pigments, coal-tar products, insecticides, etc., will be illustrated by exhibits of important raw materials, samples of the finished product and examples of merchandise finished with these products. Represented by A. W. Steudel, J. O. Hasson, L. D. Walker, A. J. Binder, B. N. Van Cleve and M. K. Barrett.

T. SHRIVER & CO.

SILICA GEL CORPORATION.—See exhibit of the Davison Chemical Co.

SLY, W. W., MFG. CO.

SNYDERFIBA CORPORATION.—Paper barrel and drum making machines in full operation, making barrels and drums in all sizes and diameters from 10 in. up to 19½ in. by 30 in. long, together with a complete display of samples of various packages and different types of heading, as used by customers. Represented by Charles Ashmun and Oscar Duryea.

SOLVAY PROCESS CO This company's products are shown in the exhibit of the Allied Chemical Dye Corporation.

SOUTHERN COTTON OIL CO., THE.—Products of cottonseed oil and the following byproducts derived therefrom: Cottonseed linters, distilled cottonseed fatty acids, cottonseed pitch and paint products. Represented by W. E. Fackert, Philip Brendel and George J. Drewes.

SOUTHERN RAILWAY SYSTEM.

SOWERS MFG. CO.—Dopp seamless steam and oil jacketed kettles, mixers, vacuum and pressure pans, and soap crutchers. Some of this equipment will be in operation. A sawed-up section of a jacketed kettle, showing the seamless construction. Also samples of over 100 different products now being made in Dopp apparatus. Photographs and blue prints of various styles of kettles and agitators, etc. Represented by A. E. Howlett, R. Bellows, Austin M. Kuhns, G. Gordon Urquhart, C. E. Brown and R. C. Boggess.

STANDARD OIL CO. OF N. J., CHEMICAL PRODUCTS DIVISION.

STANLEY, W. W.

STAR BOX & LUMBER CO.

STAR CORRUGATED BOX CO., INC.

STEIN, HALL & CO., INC.

STIMPSON EQUIPMENT CO.—Mitchell electric vibrating screen which is applicable in handling screening problems with crystalline or granular materials. Represented by James A. Lane.

STUART & PETERSON CO.—Chemical apparatus consisting of steam jacketed kettles, steam jacketed vacuum pans, porcelain-lined evaporating pans and chemical storage cans. Represented by H. E. Jacoby and F. P. Kearns.

SULLIVAN MACHINERY CO.—Working models of the Sullivan air lift and displacement pumps. Represented by L. R. Chadwick, John Oliphant and L. E. Gilbert.

SWENSON EVAPORATOR CO.—Swenson evaporators and equipment. Represented by F. M. DeBeers, P. B. Stadtler, P. H. Appell, G. Gordon Urquhart and F. F. Mackentepe.

TAGLIABUE MANUFACTURING CO.—Tag-Roesch automatic time-temperature-humidity controller. This device regulates the valves on a heating coil and a spray, so that the humidity is gradually decreased at the same time as the temperature is increased. Easy adjustments enable almost any desired temperature-humidity schedule to be duplicated. Tag automatic controllers of temperature, pressure, vacuum, time, liquid-level and condensation discharge. Tag indicating thermometers, chemical thermometers and hydrometers. Tag recording thermometers with improved operating mechanism, and evenly graduated chart, micrometer pen adjustment, pen chart-pressure adjustment, pen-lifting device, etc. Represented by L. C. Irwin, T. Dougherty, V. Wichum, W. W. White and A. Traudt.

TAKAMINE LABORATORY, INC. — Polyzime and Neco-Malt. Represented by J. W. Coleman, Jr., Milton Tanner and William Newel.

TALC & SOAPSTONE PRODUCERS' ASSOCIATION.—The various kinds of talc and soapstone mined and milled in the United States will be shown. Specimens of the crude talc rocks, ground talcs, talc crayons and articles in which talc has been used will constitute the exhibit. The aim of the producers is to call attention to the numerous and growing uses for talc and soapstone in the manufacture of paper of various grades and in textile, rubber, paint, soap, glass, ceramic, linoleum, leather and other industries as well as in the manufacture of toilet preparations.

TANNER, CHARLES S., CO.

TAYLOR INSTRUMENT CO.—A representative line of industrial indicating and recording thermometers and pressure gages, recording and indicating pyrometers, temperature and pressure regulators, laboratory thermometers and hydrometers. Represented by E. N. Hurlburt, J. W. Schwarz, F. E. Ely, J. P. Gilmore, H. W. Kugler and Walter N. Maurer.

TECHNICAL PRODUCTS CO.

TEXAS GULF SULPHUR CO., INC.—A special feature of the exhibit will be photographs of sulphur mining. Represented by H. R. Wemple and A. S. Cosler.

THERMAL SYNDICATE, LTD.—Complete line of Vitreosil, laboratory apparatus and plant equipment. Vitreosil will be shown in the transparent, translucent and opaque grades. The special feature of the exhibit will be a new type of distillation unit designed especially for the production of chemicals of high purity but adaptable to many other distillation problems, including those which require fractionating. Complete information can be obtained regarding the use of Vitreosil in sulphuric acid concentration, nitric acid, and hydrochloric acid manufacture as well as in many other specialized uses. There will be on exhibit a design showing a new type of hydrochloric-acid unit in which both the cooling and the absorption of the gas are done in Vitreosil. Represented by W. W. Winship, S. L. Tyler, W. E. Strevig and F. A. Wenman.

THERMO ELECTRIC INSTRUMENT CO.

THWING INSTRUMENT CO.—A full line of temperature measuring and recording apparatus and a line of paper testing apparatus, including basis weight scales, humidometers and tearing testers. Represented by C. B. Thwing, Edward J. Albert, H. K. Walton, J. H. Torrey and J. H. Houghton.

TITANIUM ALLOY MANUFACTURING CO.

TITANIUM PIGMENTS CO., INC.

TOLHURST MACHINE WORKS.—The following motor-driven centrifugals especially prepared for use in the chemical industry will be in operation: A 40-in. Tolhurst heavy chemical type suspended centrifugal with bottom discharge basket; a 48-in. direct motor driven Tolhurst self-balancing centrifugal with tinned basket; a 40-in. Tolhurst self-balancing centrifugal arranged for bottom discharge; a 40-in. Tolhurst center slung centrifugal arranged with covered top and bottom especially prepared for handling volatile solvents; a 26-in. Tolhurst motor drive solid curb centrifugal of the open top type, with rubber-lined case and rubber-covered basket; a 12-in. laboratory centrifugal of the semi-commercial type. Represented by W. C. Dutton, John S. Gage, B. M. Pilhashy, W. J. Westaway, T. A. Bryson, T. M. Stuart and R. K. Cheney.

TOWER MANUFACTURING CO , INC.

TYLER, W. S. CO.—Woven wire screen, ton-cap, Hum-Mer electric screen, Ro-Tap testing sieve shaker, Tyler standard screen scale testing sieves.

UEHLING INSTRUMENT CO.—Uehling CO_2 recording equipment, draft recorders, vacuum recorders, draft analyzers, absolute pressure indicators, combined barometer and vacuum recorders and various other indicating and recording instruments. Represented by F. F. Uehling, C. J. Schmid, C. C. Phelps, R. E. Terhune and H. D. Thomas.

UNION STEAM PUMP CO.—A complete line of pumping machinery for the chemical industry. Union simplex, du-

plex and triplex types of pumps for either steam or power drive. Centrifugal pumps, air and gas compressors, surface and jet condensers. A new improved rotary pump for viscous liquids. Represented by George L. Todd, R. W. Friedman and K. D. Smith.

UNION SULPHUR CO.—Represented by W. N. Wilkinson and W. M. P. Taylor.

UNITED CHEMICAL CO.—This company's products will be exhibited with those of Innis, Speiden & Co.

UNITED FILTERS CORPORATION.—Small models of an American continuous vacuum filter, Sweetland pressure filter, and United plate and frame filter press; also one complete disk and rotary valve from an 8 ft. diameter American continuous vacuum filter and the latest type of roller cake remover for automatically discharging the cake from this type of filter. Represented by Robert C. Campbell, E. J. Sweetland, L. D. Thompson and C. M. Stanley.

UNITED HAMMER CO.—A Fairbanks pulverizing hammer for use in the chemical laboratories in the preparation of pig-iron and other samples for laboratory tests.

UNITED LEAD CO.—A complete line of United acid-resisting products will be shown: Chemical lead tube lined wrought steel pipe, flanged and screwed fittings, chemical lead-lined valves, special apparatus, hard lead and block tin-lined centrifugal acid pumps, block tin-lined pipe, fittings and valves, also chemical lead-lined and covered and block tin-lined and covered special apparatus such as tanks, agitators, autoclaves and evaporators. Represented by George H. Checkley, J. W. Spotten, C. R. Andrews, C. L. Meyer, W. J. Donnan, H. Hempel and F. Freiherr.

UNITED METALS SELLING CO.—See exhibit of Anaconda Copper Mining Co.

UNITED STATES CAST IRON PIPE & FOUNDRY CO.—Details of the manufacture of castiron pipe and large castings will be illustrated by an actual section of flange pipe and pictures showing the history of cast-iron pipe, and modern methods of production. Helander barometric condenser. Represented by H. A. Hoffer, J. C. Capron and C. D. Donaldson.

U. S. BUREAU OF STANDARDS.

U. S. INDUSTRIAL ALCOHOL CO.—Various grades of alcohol and the new product "Alcorub."

U. S. INDUSTRIAL CHEMICAL CO—Thirty or forty chemical products will be exhibited by this company, among which are distilled iodine, tincture of iodine, ethyl ether, denatured absolute ethyl alcohol, oxalacetic ester, isopropyl ovalate, isoamyl propionate and ethyl isovalerate. Represented by B. R. Tunison.

U. S. STONEWARE CO.—Representative pieces of glazed acid-proof chemical stoneware, including various shapes and sizes of acid containers, pipe lines, mixers, manifolds, faucets, etc. Represented by F. S. Wills, J. J. Chamberlain and G. M. Wills.

VALLEY IRON WORKS.—Laboratory autoclaves and sulphonators of various sizes. Represented by Thomas Senior.

VALLEZ, H. A.—Two Vallez rotary filters will be in operation. Represented by H. A. Vallez and Arthur Vallez.

VAN NOSTRAND, D., CO.—New books and recent editions of standard reference works will be featured and special books relating to pure and applied chemistry will be shown. Represented by E. M. Crane, A. G. Heany and P. H. Healy.

VITREOUS ENAMELING CO, THE.—Vitreous enameled pans and traps for drying drugs, paints and chemicals and foodstuffs. Being non-corrosive, easy to clean and very durable, these pans are well adapted for use in plants where vacuum or shelf driers are employed. Represented by Harry Warman and Charles E. Bullard.

VOLAND & SONS, INC.—Assay, analytical and bullion balances and weights. Represented by George G. Voland, Emil L. Voland, Harry C. Henn, George J. Brentano, John Kistinger and John Schwab.

WAILES DOVE-HERMISTON CORPORATION.—Anti-corrosive paints, solutions, enamels, mastics and special bituminous compositions for the protection of iron, steel and concrete exposed to atmospheric moisture, electrolysis, acids, acid fumes, alkalis, sewage, brine, etc., buried in the ground or submerged in fresh, salt or acid water. The products exhibited will include Bitumastic solution, Bitumastic liquid paints, Hermastic and Bitumastic enamel and Hermastic pipe coating. Represented by Willard T. Chevalier and Ray B. Nisbet.

WALLACE, JOSEPH H. & CO., INC—The exhibit will consist of a stump from cut-over pine lands of the South, surrounded by samples of products which may be obtained from this waste wood. These products include turpentine, pine oil, rosin, tar, pitch, wood pulp, purified cellulose suitable for making gun cotton, kraft paper, fiber board and book paper. There will also be photographs and explanatory charts. Represented by Messrs. Greenwood, Burleigh and Stevens.

WALLACE & TIERNAN CO., INC.—A general line of chlorine control apparatus, including units for the production of bleaching solutions used in the paper, textile and kindred fields, for the sterilization of water, disinfection of sewage and tannery waste. Chlorine cylinder valves, Venturi type gas flow meters, pressure-reducing valves, etc., for the general chemical industry. Also dry feed equipment for heavy chemicals and the Palmer water spray apparatus for the examination of air. Represented by M. F. Tiernan, W. J. Orchard, L. H. Goebel, R. V. Donnelly, R. V. Henkel, G. D. Peet and J. C. Baker.

WEDGE MECHANICAL FURNACE CO.—Data will be available for answering questions raised by anyone interested in the Wedge mechanical burner. Represented by Leslie H. Webb and Carl S. Fogh.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.—Automatic regulator and control equipment for steel-refining furnaces. Motors for chemical industry, both a.c. and d.c., together with control equipment. Specially treated coils, George Cutter industrial lighting fixtures for indoor and yard lighting, together with other electrical equipment especially designed for the chemical industry. Represented by G. H. Jaspert, C. B. Gibson and C. G. Schluederberg.

WHEELER, C. H., MANUFACTURING CO.—High vacuum apparatus consisting principally of different types of Radojet air ejectors such as single-stage, double-stage, as well as double-stage with surface inter-condenser types. These pumps have been extensively used in chemical plants in connection with evaporators and stills for producing high vacuum, the advantage being that they have no moving parts, their operation being based on the ejector principle. Represented by Charles Lang and J. Dobson.

WHEELER CONDENSER & ENGINEERING CO.—Evaporator, condenser, circulating pumps, Edwards air pumps, steam jet air pumps, cooling tower and a brass and copper tube exhibit. Represented by J. L. Kretzmer, F. H. Schubart, E. H. Chapin, R. D. Spear and R. T. Erwin.

WHITALL TATUM CO.—An exhibit of glassware and rubber ware from crude material to the finished product, with special emphasis on "Nonsol" chemical glassware.

WHITE, WILBUR, CHEMICAL CO.—This company's products will be exhibited with those of Innis, Speiden & Co.

WHITLOCK COIL PIPE CO.—The exhibit will feature coils and bends made up of iron, steel, copper, brass, aluminum pipe and tubing. Also solvent recovery heaters, coolers, hot-water heaters, high-pressure piping. Represented by William A. Evans, C. I. Babcock, F. J. Brengel, W. C. Beekley and H. J. Anderson.

WILL CORPORATION, THE.—Ion-O-Meter, Will shaking apparatus, Will combination extraction apparatus, Faltin water still, and Will bottle washer are to be exhibited. Represented by William Dalton and R. T. Will.

WILLSON GOGGLES, INC.—Safety goggles and respirators. A new type of safety goggle of much interest to safety men will be shown for the first time. Represented by T. A. Willson and F. M. Rockwell.

WINNER CO., THE.—A demonstration of the Winner steam trap. Temperature control regulators for steam, hot water and ammonia. Winner boiler compound. Represented by Allen A. Smith, Thomas W. Monahan, R. Fruiesen and F. L. Valliere.

WINSLOW & CO., INC—A full line of acid-resisting brick and shapes. Represented by E. H. Winslow.

WOLF, JACQUES, & CO—Sizing and finishing materials, colors and mordants for fabric printing, hydrosulphite for discharge printing and stripping, textile gums for printing and finishing, soluble oils, softeners, and Monopole oil. Samples of silk, cotton and woolen fabrics printed and finished with these materials. Represented by S. E. Tylee, Jr., and others.

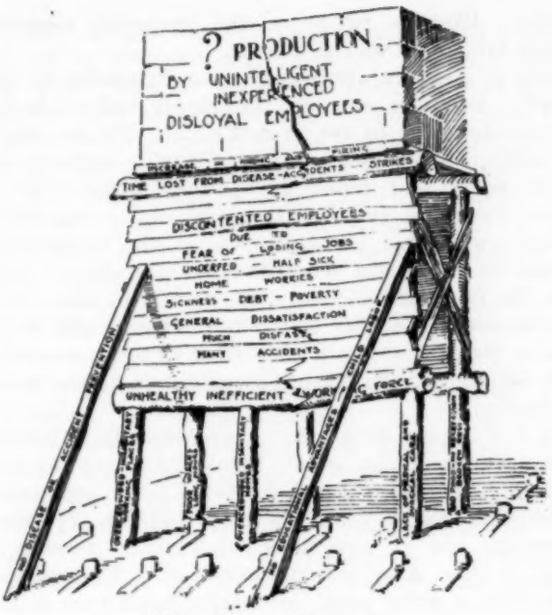
WORTHINGTON PUMP & MACHINERY CORPORATION.

YALE & TOWNE MANUFACTURING CO.—A model A-17 crane truck and a model C-6-36 trailer. These two units will be used to move the greater part of the material being exhibited from the receiving platform to the various booths. Represented by C. T. Gies, H. C. Yost and J. C. Morgan.

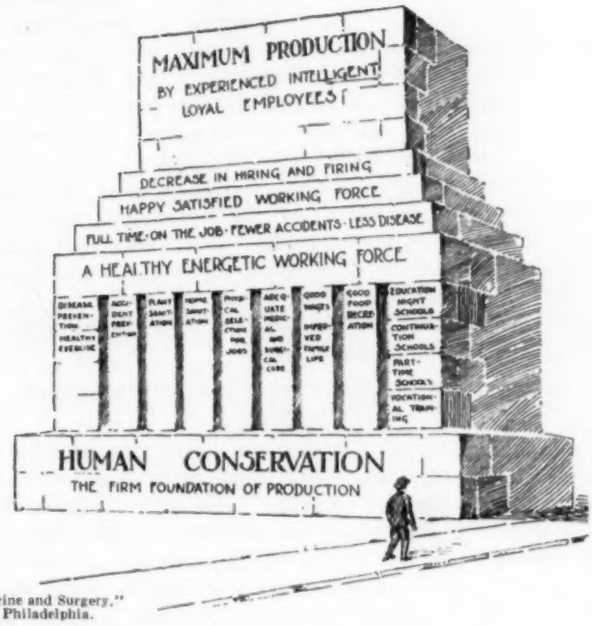
YOUNG BROS. CO.

ZAVON CO, INC—Zavon, a textile solvent used in the cotton, silk, woolen and fur industries. Represented by George A. Reeder, Esther C. Cannon, John Stokes, C. C. Harding, L. W. Kearns and C. A. Aeschimann.

ZELLER LACQUER MANUFACTURING CO., INC—Lacquers, thinners, lacquer enamels, bronzing liquids, solvents and solutions, as well as the finishes obtained through the uses of such products. Represented by Hugo, Richard, and Gustav Zeller.



HUMAN WASTE
THE FOUNDATION OF PRODUCTION



From "Industrial Medicine and Surgery," Saunders Pub. Co., Philadelphia.

Human Waste in Industry

Strong Emphasis Is Placed on the Role of the Physician in Industrial Plants, With an Outline of the Preventive and Curative Medical Services Which Can Be Rendered to the Working Forces in Industry

BY HARRY E. MOCK, M.D.
Fellow American College of Surgeons

THE physician and the engineer are joining hands in the fight against industrial waste. For the first time in the history of our nation professional fences are being torn down. Every individual, group or national organization fitted by training or experience to help in this fight are being called to the colors. Most of the problems of the engineer deal with the physical properties of the plant, the machinery and many of the economic equations of management, while most of the problems of the physician in industry deal with the physical phases of the life of the working force, both in the plant and in the home. The importance of the civil, the mechanical, the electrical, the chemical and every other type of engineer to industry has been recognized for generations. Today the human engineer is likewise becoming an important factor in industry.

Co-operation Between Engineers and Physicians to Correct Human Waste

The nation in its rapid industrial development has been prodigal with its natural resources. No greater example of this prodigality can be found than in the wasteful attitude toward human life and limb. The concerted effort now in progress to correct industrial waste promises to accomplish the greatest reforms in public health, the prevention of disease and accidents, the medical care of the working people and other human conservation measures ever witnessed in this country.

Surveys and scientific research! Make a survey and learn the size of the problem! Search and research for the scientific principles, both in engineering and in medicine! These and similar slogans during the last several years have resulted in the accumulation of a mass of information and material. We are now entering upon a period of practical application of these principles to the everyday problems of existence.

Doctors' Offices Are Recent Adjuncts to Industrial Plants

Universities and colleges, noted for centuries as storehouses of knowledge, are now becoming reservoirs of service to the people. To have a part in this greatest of all conservation movements is an honor to be sought for, and medicine with its various specialties is ready and anxious to co-operate.

The years 1909-10 mark the first concerted movement on the part of certain industries to conserve the health and limbs of their working forces. Prior to that date many concerns had their company surgeons, but the chief duties of these doctors was to anoint the bruises, tie up the cuts and splint the breaks—first aid and emergency care vitally important in any health program, but representing only one angle of the great problem of human maintenance.

At that date, a little more than a decade ago, a few industries began to establish well equipped doctors' offices in their plants, manned by broad-visioned physicians who saw in this group practice living human laboratories for their endeavors—human laboratories wherein the physician, assisted by the industrial nurse, the eye specialist, the dentist, the safety and sanitary engineer, could work out the methods of and observe the results of prevention of disease and accidents, supervision of the health of the working force, treatment of minor ailments in the plant office and supervision of treatment of serious illnesses in the homes of the employees and of all forms of sanitation in the plant, even extending his services into the hygiene of the home and the community.

Importance of Medical Work in Industrial Plants

Gradually, during the last ten years, the number of industries developing some type of a human maintenance department in their respective plants has increased. These departments have usually featured or stressed certain angles of the human engineering program—few concerns have developed a comprehensive, rounded system. For example, one industry has stressed welfare work, and because it has a competent social worker in charge, feels that it is meeting excellently this problem of human maintenance; another has stressed the "safety first" work, and depends almost entirely on its safety engineer to reduce human waste and he in turn can scarcely see how anything but accidents could cause human waste in industry; other industries have stressed the "industrial relations department," usually headed by the employment manager, and he too frequently cannot see the importance of the medical work as a definite part of the industrial relations or curtails the expense of the medical department in order to stress some other angle of his problem—the lay mind cannot grasp the importance of health supervision, early diagnosis or expensive emergency care to prevent more expensive prolonged illness and disability.

On the other hand, too many industries have stressed the medical work and have neglected the other angles of human maintenance—sociological work, employment, safety and sanitation. Again, many of these concerns have fooled themselves or have been fooled into thinking they have a medical service when they employ a cheap doctor for a few hours a day and one or two visiting nurses, and carry on a medical service which is a mere mechanical routine, a farce, a service in name only. The doctor who is only using his industrial practice as a "pot boiler" is not usually interested in the great problem of reducing human waste in that industry.

Of the 2,200 physicians, good, bad and indifferent, engaged in some form of industrial health service in the United States, 500 have affiliated themselves with the American Association of Industrial Physicians and Surgeons. This organization stands for the best possible medical service, preventive and curative, which can be rendered to the working forces of industry. Of this latter number it is conservative to estimate that at least seventy-five are serving great industries which have whole-heartedly adopted every method advocated to conserve the human forces in their employ. From their experiences abundant data have been accumulated to prove our charge of excessive human waste in industry; likewise to prove the remedial measures adopted are sound and effective.

There is a strong appeal to human sympathy in this subject. As Americans we thoroughly believe in the principle that all men are created equal. We are gradually adding a supplementary principle—namely, are created equal and must have equal opportunity to survive, re-create and live in peace and contentment. However, with this human appeal in the background, I intend to emphasize solely the sound economic principles, the increased efficiency, the saving in labor turnover, the accrued profits to the management and to the workers, the conserving of the nation's human resources which inevitably follow the elimination of human waste in industry.

The last census shows that approximately 42,000,000 persons compose the great industrial army of this country. Figures gathered by the U. S. Commission on Industrial Relations in the years 1913 to 1915 show an average loss of nine days per year on account of illness to the American wage-earner. Figures collected from a great many industries having good, fair or indifferent systems of medical supervision of their working forces show an average of four to seven days per employee lost annually due to sickness. Thus it is evident that even an average type of health supervision will cause a reduction of at least three days per employee in the annual morbidity rate. The cost of the medical service, including many other functions besides those of health supervision, did not exceed an average of $2.25 per employee per year in ninety-nine industries surveyed by Magnus Alexander.

Economic Loss Due to Sickness

Reducing industrial waste due to sickness by a plan of medical supervision of the entire wage-earning force of the country would result in the following saving in dollars and cents to industry, to the individual and therefore to the community:

42,000,000 workers, losing nine days per year, at an average wage loss of $3 per day (42,000,000 × $27)	$1,134,000,000
Reduction of three days per year by medical supervision leaves six days' annual loss, or 42,000,000 × $18	756,000,000
Saving in lost wages to employees	$378,000,000
Cost of medical services necessary to accomplish this, as well as many other forms of savings (42,000,000 × $2.25)	94,500,000
In normal times we may assume that the loss in production or in the efficiency of the entire working force equals at least the amount paid in wages, therefore reduction of sickness would save to industry and to workers	283,500,000

Economic Loss From Accidental Injury

Quoting from Dr. Eugene Fisk, we gain another viewpoint on the monetary loss resulting from accidents in industry:

If, as Mock estimates, 200,000 people are permanently disabled by industrial accidents annually, and if we assume that $35 is the average cost of replacement, this means a direct waste in turnover alone of	$7,000,000
Add to this for those disabled four weeks or more (875,000 × $35)	30,625,000
Add for those killed (28,000 × $35)	980,000
Increased production costs due to industrial accidents	$38,605,00

At least 75 per cent of the accident rate is preventable.

Even greater reduction has been made in some plants by safety measures and education. The economic value of these lives on the lowest basis of computation is $8,000 each and the saving of 20,000 of them (75 per cent) would mean an economic gain of $160,000,000.

Accidents cripple the efficiency of the working force. Trained employees who are injured must be replaced by new, often inexperienced, workers. It is hard to estimate the loss to industry by this form of forced labor turnover.

Accident Prevention Is Cheaper Than Paying Compensation

Injured employees, non-producers now, cost industry a terrific toll in compensation. In Pennsylvania the gross total of workmen's compensations awarded and paid for fatal and disability cases during two and a half years, Jan. 1, 1916, to July 1, 1918, amounted to $16,917,000—the amount actually paid to 577,053 injured workers or their families. A cheap price surely, for of this number 3,789 lost either arms, legs, hands, fingers or toes; 1,157 lost one eye; 29 were totally blinded and 7,575 were killed outright. It is difficult to estimate the cost to the industries or to the injured employees (or to the doctors and hospitals often forced to give free care) for the medical and surgical services to these cases.

Figures from many states having compensation laws would indicate that considerably more than $100,000,000 annually is disbursed in payment of compensation claims to injured workmen throughout the United States. One-half this sum spent by the states in an intelligent accident prevention program would reduce accidents 75 per cent and the amount paid in compensation at least three-fourths. Prevention is cheaper than paying compensation. Compare these two items:

No accident prevention, cost of compensation		$100,000,000
State accident prevention programs, cost	$50,000,000	
Cost of compensation for reduced number of accidents	$25,000,000	
		$75,000,000

Here is one common meeting ground for engineers and doctors for the elimination of one of the most appalling examples of wastage in industry.

Economic Loss From Preventable Diseases

Statistics innumerable can be furnished to prove the economic loss from preventable diseases and accidents in industry. But statistics are not as convincing as actual examples of a few methods of preventing human waste.

Engineers can readily understand the importance of examining one thousand intricate, expensive machines which the management of the industry had decided to install. Naturally, this examination would be made before setting up and using the machines, especially if certain damaged parts in the mechanism might cause an explosion which would damage, perhaps irrevocably, some of the other machines. Why not, then, the same solicitous care of the human machine?

When I was making a plea for certain preventive measures which would reduce the number of accidents to our soldiers from industrial causes during the recent war, an old medical army Colonel said to me: "The soldier is the cheapest commodity we have in this great war machine. We expect them to get injured, wounded and killed." He was a small-caliber, narrow-minded officer, of course. The majority of those in authority saw the value of prevention, realized that the fighting man was the most expensive commodity in the army. The idea of prevention was thoroughly sold to this great industry organized for the purpose of war.

Today, and more true of the past, too many employers and captains of industry have looked upon the worker, the soldier in the industrial army, as the cheapest commodity in his institution—a machine to be used to the utmost and when premature age, sickness or injury overtook it, to be scrapped without further thought. The idea of the expensiveness of this machine and the economy of conserving its usefulness by preventing these misfortunes must be as thoroughly sold to industry as it was to the army.

Economic Loss Due to Unintelligent Hiring of Applicants for Work

The old system of hiring and placing a man on a job and the system still in vogue in many industries was to have the foreman or the employment manager interview the applicant, ascertain his occupational qualifications and then assign him to the job. No thought was given as to whether the man had a bad heart or high blood pressure or an incipient kidney disease when he was assigned to the heavy work of trucking, running a roller machine or running up a ladder fifty or a hundred times a day. Yet this heavy work, incompatible with his damaged physical machine, was responsible for his premature breakdown and mayhap his death. The expense of hiring that man and breaking him in to a job for which he was physically unfit was a dead loss to the industry. Nevertheless he was replaced by the same stupid, blind method of hiring. No thought was given as to whether the man employed had tuberculosis. He had, but he was placed at the job of packing in a poorly ventilated room, in close proximity to a hundred fellow employees. The dust from the packing paper made his disease grow rapidly worse. His coughing and occasional spitting infected three of the men working near him. Just as he was becoming a good packer he was forced to quit. Fear of losing his job and placing his family in want had kept him at work on the days when he should have been home in bed. When he finally gave up the fight his disease was so advanced it was incurable. The three other men, with gradually decreasing efficiency, continued to work until the foreman said:

"What's the matter with you men? You used to be good packers, but now you're no good a 'tall. Get out! You're fired!"

Four men thrown on the scrap heap! Four families a drain on the community because of the unintelligent system of hiring and firing so prevalent in industry! In these same industries expensive intricate machines are very carefully examined by engineers.

Annually throughout the land thousands of such cases of organic disease, kidney trouble, tuberculosis, syphilis, mental and nervous disorders and other incipient disease conditions are being blindly employed, permanently damaged, menaces to fellow employees, and prematurely scrapped as the derelicts of industry. Here is another field where experience has proved that wastage in industry can be eliminated.

Examination of Applicants for Work

In 1912 the routine medical examination of applicants for work before they were placed on the job became

a definite function in a few large industries. Later, in 1914, other industries took up this system in order to protect themselves against employees with deformities, hernias, one eye blindness, etc.—conditions which might make the concern responsible for compensation, as in that year employees' compensation acts were passed in a few states. In some industries there were selfish reasons behind the adoption of this method, but among the pioneers in this field humanitarian reasons and sound, scientific business principles prompted the action.

The examination of applicants for work should be for the sole purpose of discovering:

First, those applicants who have some condition in their bodies which makes their presence in the plant dangerous for themselves, for others or for property.

Second, those applicants who have physical or mental defects not entirely unfitting them for employment, but which require careful selection of work in order to preserve their health and make them efficient workers.

Carefully conducted physical examinations will show between 2 and 3 per cent of all applicants totally unfit to work because of conditions enumerated in the first class. Approximately 25 per cent of the applicants will have some diseased condition which can be corrected or which requires the selection of his work as explained in the second class.

Scientific placement, therefore, in order to reduce this form of human wastage in industry, necessitates close co-operation between the physician and the employment manager. The first learns the physical qualifications of the applicant, the latter his occupational qualifications. Scientific placement results according to the following formula:

Physical Qualification
\+ *Occupational Qualification*
= *Job*

Economic Advantages of Medical Examination of Applicants for Work

The number of applicants who have contagious diseases is not great, but even one case of diphtheria or scarlet fever thrown in among the old working force becomes a potential factor for great havoc, a destroyer of efficiency and an added loss to industry. In one year the writer and his assistants examined 8,000 applicants for work and found 170 cases of contagious diseases, all of whom were rejected permanently or temporarily, as follows:

	Cases		Cases
Tuberculosis	102	Mumps	6
Syphilis (active)	10	Streptococcic sore throat	18
Gonorrhea	16	Smallpox	1
Diphtheria	8	Traucoma	1
Scarlet fever	2		
Measles	6	Total	170

It is self-evident that the health of employees in this industry was greatly protected by preventing these applicants from going to work. The financial saving to the concern by preventing at least five possible epidemics among their working force cannot be estimated.

Four years ago I obtained figures from ten large industries having a total working force of 102,400, which conducted careful medical examinations of applicants for work. The profits to these ten employers from this system amounted to $288,000 in one year after paying for their entire medical and nursing services, including all the other functions of the medical departments. Details of these statistics can be found on page 88 of Mock's "Industrial Medicine and Surgery."

Health Supervision of Working Force

It is customary for engineers periodically to inspect and examine the plant machinery in order to discover early the signs of wear and tear and when necessary to repair in order to preserve its working span and effective operation.

In a nutshell, that is the purpose of the physician in industry—the human engineer. Not only must the portals of the plant be guarded against unsafe applicants for work but the old working force must be constantly supervised to guard against contagion and epidemics among its members; to discover the incipient diseases early before their advance has robbed the concern of competent, trained workers; to see that the sanitary conditions outside in the community, inside in the plant, and among the employees are such as to conserve health, contribute to their contentment and by all of these add to or maintain their efficiency.

Periodical physical examination, or the examination whenever otherwise indicated, of the old employees is the best method and only scientific means provided for a thorough supervision of health. If these examinations are slipshod or merely routine, devoid of all personal interest in each individual case, very little value accrues to either employee or employer. But if medical talent is employed in whom the managers and foremen have confidence and if every laboratory and other facility is given to examine the workers thoroughly, then great value accrues to the management, to employees and to the community. Such a medical department becomes a veritable community health center and has untold influence over the health of the families of the workers. Without attempting to give home medical service to the families, many opportunities are presented for the visiting nurse or the doctor to relieve illness in some member and thereby relieve worry and increase the efficiency of the wage-earner. After an employee has been thoroughly examined in the doctor's office at the plant, he insists on a thorough examination of some member of his family when that one is forced to consult the family doctor. Thus even the caliber of the outside physician is improved. Not only does an efficient medical department decrease industrial waste but its influence and ramifications decrease human waste in the community itself—preserving to each industry a healthier, more loyal future generation of wage-earners.

Work for Dentists and Eye Specialists in Conserving and Reclaiming Employees

Dental departments in industry have become established units of the medical system in at least fifteen concerns. They are absolutely vital in discovering the diseased conditions about teeth, especially those conditions which insidiously lower the vitality of the worker and often are responsible for the absenteeism which is thought to be due to some other disease. No system of health supervision is complete that does not include dental examinations and some arrangement whereby remedial measures can be placed within the financial reach of each wage-earner.

The eye specialist has become invaluable in the program of conserving and reclaiming employees. In various industries from 35 to 56 per cent of the employees were found with defective vision uncorrected by glasses. While thus far I have found no method of computing the increased output of these workers after they were fitted with glasses, yet the testimony of many managers and foremen indicates that practically all of them have become more efficient and steadier on the job. The good eye specialist can increase the efficiency in whole departments by suggesting and supervising changes in illumination. He can help enforce the protective measures installed for the prevention of eye injuries.

Waste From Minor Injuries

Besides the usual measures incorporated in "safety first" and accident prevention programs, the physician in industry can eliminate many sources of waste the result of accidents. Minor injuries are said by accident casualty companies to cause considerably over 50 per cent of the disability cases. This is due to the fact that most of these slight injuries are neglected until some complication, usually an infection, forces the worker to consult a doctor. Forcing every case, no matter how slight the injury, to see the doctor in the plant at once and the use of tincture of iodine on every scratch, pin prick, nail wound or other lacerating wound have resulted in a great decrease in infections and in minor injury disability. Sherman reports only 0.1 per cent of all accident cases in the Carnegie steel mills become infected. In my experience I found that 78 per cent of all accident cases reporting to the doctors' office in 1909 were infected. By instituting the rules about reporting and using tincture of iodine at once there was an immediate reduction of 28 per cent in the number of infected cases. This decrease continued until only 7 per cent of all cases showed the least sign of infection and only 0.2 per cent lost time on account of infections.

Immediate care of every injured employee, treating each case as serious from the moment of injury and the use of the best hospital facilities will reduce the lost time on account of accident disability and will reduce materially the number of cases of permanent disability and permanent deformity. Here again careful physical examinations of the employees will often reveal potential causes in the human machine for accidents either to themselves or to fellow employees.

Real co-operation must be developed between safety engineers and physicians in industry to obtain 100 per cent value from any accident prevention program.

Casualties in the Industrial Field

It is conservative to estimate that the casualty lists from the industrial army in one year in this country are at least three times greater than the casualty lists sustained by our army in the World War during the bloodiest year of fighting. Millions have been spent by the Federal Government for the reclamation of our disabled soldiers, and a great many more millions must be spent before the nation's promise of rehabilitation to the disabled is even properly administered, let alone realized. These efforts to rehabilitate the soldier have awakened the nation's conscience to the importance of rehabilitating or reclaiming the disabled from industry.

From the industrial field alone, consulting statistics furnished by the Department of Labor in 1917, one finds that annually 875,000 men and women are disabled for more than four weeks as the result of accidents sustained in industry; that annually 76,000 suffer loss of members, and at least 200,000 are otherwise permanently disabled by industrial accidents, that each year 28,000 are killed as a result of industrial accidents. Conclusions drawn, after the investigations of many different authorities, indicate that at least 250,000 wage-earners are lost annually in our country due to occupational diseases.

Reclamation of the Disabled

With the exception of some of our large industries and a few far-visioned insurance companies, practically no organized effort has ever been made for the reclamation of these hundreds of thousands of permanently disabled men and women. A few industries salvage their disabled, making them efficient and independent, others give injured employees easy jobs where they can make a living, but the very softness of the job robs them of all incentive, and the bitterness engendered by dying ambition adds to their incompetency, forcing them on and on to the scrap heap. The majority of concerns settle with and then dismiss their injured workmen for whom they are legally responsible; the disabled for whom they are morally responsible are scrapped without a settlement. These men, trained for certain occupations, who meet with permanent handicaps, are the waste products of our industrial life. Too often when the handicapped individual is employed he is ineffective, because the job was chosen for him without considering his physical fitness for it. Many of these disabled men for whom no employer feels responsible drift from one job to another, constantly dropping to a lower level, until finally they relinquish all effort to work. These become the loafers, the beggars on the corner, the shoestring merchants on the street, the poor, physically handicapped and mentally debased flotsam and jetsam of our civilization. The great majority of these handicapped persons cry out not for charity, not for the easy job, but for a chance to make good and to advance. The testimony from a great many employers who have employed handicapped individuals indicates that they are efficient, capable and will often stick by the job better than the able-bodied man.

Needed Federal Laws for Vocational Training of the Handicapped From Industrial Accidents

I prophesy that within the next ten years every state in the Union now having employees' compensation laws will likewise enact laws and establish machinery providing for the rehabilitation of these permanently handicapped individuals. Already Rhode Island, Pennsylvania, California and Illinois have adopted rehabilitation laws providing for more or less limited efforts along this line. The Federal Government has enacted the Smith-Sears bill, which deals with the vocational training of the handicapped from industrial accidents by co-operating with state efforts. All of this is more or less piecemeal legislation, especially the latter law, as vocational training constitutes only about 10 per cent of the problem. It is placing the cart before the horse, but nevertheless even this law indicates an awakened conscience on the part of the lawmakers.

In an effort to work out a practical solution of the entire problem of rehabilitating the physically handi-

capped both from accident and disease, an organization has been perfected in Chicago during the last year, composed of leaders in industry and education, a large group of women representing the various social agencies, and a medical board of representative physicians and surgeons of the city. This is known as the Service League for the Handicapped. It has an executive committee made up of fifteen of the most influential business men, with medicine, education and safety engineering also represented. Its board of management is composed of delegates from almost every agency in the city dealing with some phase of the problem of the handicapped. Through its connections with the public school system, the universities and many industries and through its own workshops which are now established, practical re-education of the handicapped for lucrative employment is made possible. It maintains an employment bureau which directly or through the state and private employment agencies is successfully replacing many handicapped individuals in industry. This Service League stands as a halfway house between hospital, where the reconstructive surgery is done, and the future employment of the disabled, where his rehabilitation will be completed.

No plan for eliminating human waste in industry is complete that does not include this salvaging process—a process which aims to reclaim those who become disabled in spite of all the great preventive measures which are being advocated or have been installed. Keep in mind human salvage as well as the elimination of human waste.

Community Co-operation

The burden of the care of the sick and injured from industry must fall on either the individual, industry or organized charities, when neither the first nor the second is responsible financially for that care. The succor of the individual and of his family by the charities is humiliating and after all is a tax, as the majority of the community must contribute to charities. Frequently the burden is too great for the individual endeavoring to carry it alone, and as a result insufficient or improper medical, surgical and hospital care is obtained, resulting in prolonged disability and often complete loss of the wage-earner, either being a very material loss to industry. Many large industrial concerns and groups of smaller industries have proved their ability to organize efficient medical departments. These, or insurance companies representing them, assume the cost of furnishing adequate medical and hospital care and the additional cost of paying compensation sufficient for the family to maintain its integrity and its natural position in society, and add the expense of such protective measures to the cost of production. Even this burden is a tax on society, for the consumer must ultimately pay, yet the benefits in return to all society offsets this tax a thousand-fold.

The alternative method is for the state to impose a sufficient tax to meet these problems of prevention, treatment and reclamation of the disabled wage-earners. Personally, I do not believe many states are equipped to handle the problem as efficiently as are individual industries or groups of smaller industries. The tax would undoubtedly be much greater than if the burden was carried by a small addition to the cost of production.

The physician in industry more than any one else has come to realize that the questions of health in industry, as well as many of the other industrial relations problems, deal not only with the individual employee, but rather with the employee and his family.

Community Health Centers the Solution for Eliminating Human Waste

When considering the preventive and the remedial measures as a means of eliminating human waste in industry, all methods developed must be applied to the community as a whole. The organization of community health centers to which industries will contribute for the adequate supervision and care of their working forces will undoubtedly be the ultimate solution of this great economic and social problem. Such centers would enable the development of a co-operative plan between community and the industries of that community for the purpose of eliminating human waste. It would safeguard for industry the expensive human machine while employed in the plant, while on the streets and while at home. It would guarantee a better system of preventive medicine, better medical and surgical care, better hospital provisions and would prolong the work span and life span of every individual.

Laying aside the old doctrine of "the survival of the fittest," we seem to be entering upon a new era—the conservation of man, the noblest work of God.

Chicago, Ill.

Loss in Production Due to Ill Health

A report on national vitality prepared in 1909 for the National Conservation Commission, appointed by President Roosevelt, estimated that there were then about 3,000,000 persons seriously ill at all times in the United States. This meant an average annual loss per person of thirteen days owing to illness. It was estimated that 42 per cent of this illness was preventable, and that such prevention would extend the average life by over fifteen years.

The committee appointed by the Federated American Engineering Societies to study the elimination of waste in industry states in the summary of its report (July, 1921) that since the 1909 report was issued an evident reduction in illness has been accomplished, so that today an estimate of between eight and nine days is probably near the fact.

Tuberculosis is the most important disease among industrial workers, two or three deaths per 1,000 per annum occurring at the working ages. It is estimated that 3 per cent of the wage earners, or about 1,250,000 lives, are affected. The economic loss from tuberculosis death rate as affecting the working population is $500,000,000 annually.

Pneumonia, influenza and typhoid fever are the most important communicable diseases among adults. Influenza and pneumonia, in non-epidemic years, take about 35,000 lives in the working ages and account for at least 350,000 cases of illness. Typhoid fills close to 150,000 sick beds annually and takes 15,000 lives, mostly in the working ages.

In a large industrial area hookworm infection was present among at least 5 per cent of the laboring population.

Malaria is so seldom a direct cause of death that it is difficult to estimate its extent and influence, but it is responsible for much sub-standard health, and probably affects 1,500,000 persons annually, covering 27,000,000 days' absence.

Waste Due to Poor Engineering and Management

Sound Engineering Practice and Competent Management Are the Most Effective Methods of Eliminating Waste—Accurate Cost Records of What Has Been Done Should Make Possible the Prediction of Improved Results

By DEXTER S. KIMBALL
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FOR a number of years certain industrial engineers have been advocating a more careful consideration of industrial wastes as a part of more efficient management. Received rather complacently at first by managers, this idea has now grown to be one of the most prominent and also one of the most promising fields of industrial betterment. The appointment by Mr. Hoover, as president of the Federated American Engineering Societies, of a special Committee on the Elimination of Industrial Waste has done much to arouse still greater interest in this matter, and the forthcoming report of this committee is expectantly awaited. A very interesting feature of this report is a recommendation that uniform cost systems be established in all industries as a means of evaluating and checking industrial waste. This is a perfectly logical conclusion. Costs, if properly considered, are financial statements of what has occurred. They provide a basis for comparison of results and also for predicting future policies.

What Is Industrial Waste?

Like all seemingly new industrial problems that receive such publicity, the elimination of industrial waste will be much discussed, no doubt, and possibly some extravangent claims will be made concerning it. Some confusion seems to exist also in the minds of some of those who have discussed the matter as to just what is definable as industrial waste, and before going further it may be well to inquire just what the term really involves; for waste can be prevented only when it is understood.

Waste of Materials

Waste of materials is usually quite tangible and, hence, usually preventable. If a workman uses more material of any kind than is actually necessary for a given operation, waste results; or he may waste material through spoiling the work on which he is employed. Material may be wasted through inefficient or inadequate equipment, as in the case of a boiler room where coal is not properly burned. Also great material wastes often occur because of careless handling and storing of material, through actual loss of material and through preventable depreciation.

Labor Wastes

Labor wastes are not always so evident. If a man expends more time upon a piece of work than is necessary, waste results; or if he is paid for time during which he does not produce, money is wasted. Time may also be wasted through the use of inefficient equipment or poor methods. The loss through these last two resources are often very great and often not appreciated.

It does not follow, however, that waste results when a man works eight hours when he could work ten. Perhaps eight hours is as long as he should work. Nor can it be said that there is a waste because a plant operates only eight hours out of the twenty-four. In some industries it is necessary to operate continuously to produce economically, but the term "waste" must be applied with care to the period during which a plant operates. Again, it does not follow that a workman wastes time because he is not working every minute of the time for which he is paid. He usually can produce more product if he is given definite rest periods. This is a fact proved by actual experiment.

Idle Equipment

Losses and wastes due to idle equipment are also somewhat elusive. Clearly there is a waste of time and of interest on investment when a machine stands idle though there is work for it but, because of poor planning, the work is not ready. It does not follow, however, that all such idle time of equipment is chargeable as waste. Quite frequently, and particularly with large equipment, it is not possible to keep all machines in operation; yet these machines may be absolutely indispensable to the life of the business. The interest on investment during idle periods is a just charge against production, and should be so recognized and cared for in the costs, and if this is done, such interest cannot be classified as a waste. It may occur that the line of work that demands machinery and equipment which operate only occasionally does not pay a profit, and in such case the entire procedure may well be called a waste.

All Wastes Not Preventable

It should be remembered also that all wastes are not preventable. Wastes of material and time through carelessness or bad management can usually be reduced to small amounts, if not entirely eliminated. But buildings and other property, even when kept in good repair, waste away slowly and in course of time must be renewed. Unless provision other than repairs is made for such wasting away the capital invested will in time be depleted. And again it may not pay in some instances absolutely to prevent all waste. Thus the wasting losses through radiation from a steam pipe may be reduced to a small amount by covering the pipe with a thick layer of non-conducting material. The cost of covering the pipe with a layer of such material, thick enough to prevent any radiation whatsoever, would in all probability be greater than would be warranted by the saving made over the case where a moderately thick layer was used.

The foregoing brief consideration of industrial wastes should make it clear that wastes cannot in general be detected by casual observation. In many cases, of course, the waste may be so apparent as to be so detected, but many large wastes are difficult to detect and difficult to prevent. And it will be obvious that unless the character of the waste is known it is most difficult to prescribe remedies for it. This is particularly true of wastes due to careless or inefficient management and organization. And even when the character of the waste is obvious it is not often easy to evaluate by observation the amount of the loss occasioned.

Prevalence of Lack of Knowledge

Most industrial waste and loss are due to lack of knowledge, and many data are available which indicate that the majority of business failures are due to incompetence; particularly that form of incompetence that comes from lack of accurate knowledge of some part of the business.

Bradstreet's reports for 1911 and 1921 give some very interesting data on the matter which indicate that four-fifths of the business failures in this country are due to incompetence of one kind or another on the part of those that fail. And no doubt much of the incompetence comes from lack of knowledge regarding some phase of the business, and particulaly regarding wastes and wasting losses.

One of the most effective methods of evaluating wastes is through the cost system, and no cost system is worth considering that cannot be used to evaluate any given waste. The character of wasting losses naturally varies with the character of the business, though some wastes, such as depreciation, are common to practically all industries. A cost system may or may not reveal the character of wasting losses in a given industry, but cost-finding methods can always be employed to evaluate any loss once its character is determined. Every careful manager should therefore study carefully the wasting losses peculiar to his business, evaluate them by financial standards through his cost system and proceed to eliminate, as far as possible, those that are important enough to be considered. A few particular cases may make these points clearer.

Lost Time

In all industries there is more or less lost time. Machinery breaks down or lights are temporarily extinguished, thus causing temporary idleness for which pay is not deducted; or workmen are idle because work or tool is not at hand. In many cost systems such lost time is charged directly to some productive job order number and thus buried in the cost. If the amount of lost time is small, this may be all right, but a better procedure is to carry all such lost time to a separate account and distribute this account in the expense or overload. Such an account becomes a measure of efficiency in management and will show not only the amount of such losses, but can be made to show the responsibility for such losses. Usually the most of these losses are due to poor planning of the work on the part of those in charge or to inefficient care of equipment and lack of foresight in keeping important machinery in proper repair. Such an account will not, however, reveal wasted time due to "loafing" on the part of the workers themselves.

Lost time in its relations to the payroll may be very important in itself, and if the idleness involves high-priced machinery, this factor may be of much greater importance, since then there is loss of interest on invested capital. This type of loss has several aspects. First, there may be loss of time in operating machines well fitted for the work in hand for the reasons already enumerated. Again there may be waste of time because of work performed on equipment not well suited for the purpose. And, lastly, there may be machines or processes in the plant that are used to such a small degree as to be a source of loss instead of profit. Occasionally, of course, as has been stated, machines and processes may have to be retained, though used only occasionally because of some peculiarity of the business. But an examination of many plants, particularly old plants, will show equipment and apparatus that are occupying valuable space and yet yielding so small a return as to constitute a loss. The case is analagous to the farmer who keeps an unproductive hen or cow, and the remedy is the same in both cases—through cost-finding methods. A record of all idle time for all equipment and a comparison of this idle time with the earnings of machines showing a large amount of idleness will often result in changes in equipment that will cut off much wasted time. Information of this kind can be easily obtained through ordinary cost-finding methods.

Storekeeper Cuts Down Waste of Material

Good cost methods are always useful in preventing wasteful use of material. It is still customary in many shops to permit workmen to draw material at will from the stores. It is true, of course, that in small shops, particularly where the material is of no personal value, it may not pay to employ a storekeeper and workmen may be permitted to help themselves from bins and racks. Such cases are rare, however, and usually it pays to have a storekeeper. It is a small enterprise indeed where a storekeeper will not save his wages. It is universal experience that workmen, when allowed to draw material at will for fabrication or general supplies, become careless and wasteful not only as to the quantity drawn but also as to its economical use. Loose storeroom methods also are likely to lead to dishonesty and petty pilfering on the part of employees.

Under a good cost system the storeroom is closed to all but the storekeeper and his assistant, and no material may be issued without a proper order any more than money can be obtained at a bank without a check. Material is just as valuable as cash in the safe and should be so treated. Under a good cost system all material drawn is charged to some production or expense order and properly accounted for. Aside from the actual savings made by properly regulating the withdrawal of material from stores, such regulations serve to accentuate constantly the value of material and assist in forming habits of thrift in all concerned.

Material wastes due to overissuing or careless drawing of material can be kept in check by good storeroom and cost methods. There is usually, however, a considerable amount of unavoidable material waste due to cutting, sawing and other fabrication processes. In the case of copper and similar valuable material, these wastes may be considerable, and even with

cheaper material, as sheet steel, when large quantities are used the value of the scrap may be great. If the waste is in such form that it may be returned to stores and used again for other purposes, the cost system should be such as will credit the original job with such salvage value as may be fair to it.

Depreciation of Material

Another common source of material waste is depreciation of stores materials due either to poor storing or to obsolescence. The remedy for the first cause is obvious, but the second is not always so easy to recognize or to obviate. Obsolete unworked material usually comes from careless ordering or changes in design, and many kinds of stored material depreciate rapidly, particularly if it is at all special in character. Finished product often depreciates through obsolescence due to changes in market conditions. Cost-finding methods, as usually operated, will not reveal such losses, but a close study of the inventory will make such losses apparent. The engineering or designing department can do much to lessen these losses by consulting the inventory when designing new apparatus so as to use material on hand where possible.

Depreciation of buildings and equipment through wear and tear, action of the elements, obsolescence, etc., are, however, wasting losses that can be and should be clearly shown and compensated for in the cost system. The method so much in use of charging off depreciation as a lump sum or percentage annually is no longer considered good business accounting. Losses of this kind are a legitimate part of costs and should be included so far as possible in the charges made for each machine and process as the work passes through them. In all good cost systems systematic provision is made for including depreciation in the regular cost of production. In this way, and in this way only, can intelligent compensation be made for such losses.

Spoiled Work

An excellent example of the value of a cost system in evaluating wastes is in connection with spoiled work. It is still common practice to charge spoiled work to the job order number under which it has been performed. If the spoiled part is one of a large number, this procedure may often be defended. But more modern practice is to carry the cost of spoiled work to a special account that is discharged into the expense or burden as in the case of lost time. No matter what disposition is finally made of such an account, the practice is good in that such an account gives the manager an idea of the magnitude of this waste and the information necessary to correct the loss if it is serious. Spoiled work, like lost time, is a measure of the efficiency of management. Some managers go so far as to keep a record of the breakage of small tools and apparatus by individuals partly as a means of evaluating the loss and partly as a psychological check on carelessness.

Other specific examples could be given of the relation between cost finding and wastes, but the foregoing should be sufficient to indicate these relations. Obviously these wastes may be due to incompetence or carelessness on the part of either employer or employee, or both. Wastes due to poor management are not always easy to detect or evaluate. Thus a rearrangement of machinery or changes in administrative methods may not be reflected in the costs as clearly as in the examples cited. In general, however, all such changes must eventually affect costs in some way or another, and in fact the result of any and all charges can be evaluated accurately only by a study of comparative costs.

Planning in Advance

The foregoing discussion has assumed that costs are considered only as a record of what has been already accomplished, and this is the usual conception of cost-finding methods. A more modern view is to consider costs as results to be attained, planning deliberately to arrange machinery, personnel and wages in advance so as to produce the desired result; and advanced thought in management is moving steadily in this direction. Careful consideration will make it clear that wastes such as lost time, material wastes, losses due to broken machinery, etc., can be greatly lessened by careful planning and foresight. The planning department, which aims to accomplish these results, is now a common feature of modern plants and many enterprises that produce complex and refined products are now running on schedules prepared in advance that cover the entire range of operations in which all time elements and all ways and means are predicted in advance of production. Undoubtedly the remedy for much industrial waste lies in managerial changes of this kind.

It will be clear, for instance, that if the amount and quality of material for a given piece of work are determined in advance and provision is made so that only this amount of material can be drawn for this purpose, much of the material waste now so common in many plants would disappear. The case of plant supplies is equally clear. Every manager knows that when workmen are free to help themselves freely to oil, brooms and similar material the tendency to waste the supplies is almost irresistible. Many careful managers now determine in advance just what the needs of each man may be and arrange a budget for all supplies, thus preventing unnecessary waste. Departmental expenses can be budgeted in a similar manner. It will be noted that aside from the actual savings thus attained, such methods tend to stabilize the costs, making prediction much more definite.

Function of the Modern Cost System

It should be remembered, however, that budgeting and predicting of costs in advance can be accomplished only after accurate data are available. The power to predict in advance rests generally upon a knowledge of what has already been accomplished. A modern cost system, therefore, should perform two functions—namely, recording what has been done and making possible the predicting of what should be done. It does not follow because a piece of work has cost a given amount that it cannot be performed for less than that amount. One of the greatest criticisms of modern cost accounting methods is that usually they tell simply what has occurred and do not show what should occur. If the manager can have placed before him the statement of work accomplished and also a statement of the wasting losses and other defects in his organization and methods, it is usually not a difficult task to make such changes as will make prediction of results and the attainment of the same a hopeful possibility.

Ithaca, N. Y.

The Educational Waste in Industry

By Hollis Godfrey
President, Drexel Institute, and Chairman, Council of Management Education.

IF IT be true that 50 per cent of the waste today in industry is due to management, the fault lies in industry and the college. That 50 per cent may be termed the educational waste, as it never could exist had there been proper co-operation between the colleges and industry in the past. The energy of education is the one force which is directed to stop management waste. Education is the salvation of industry.

College Man, Properly Trained, Needed

Go to the captain of industry today and ask him what type of man he needs in his management group. He will tell you the college man when properly trained. He will tell you that the average college man is not properly trained and that for two years he is virtually useless to the organization; he will tell you that it costs at least $2,500 to train that man before he can accept a position of responsibility in the company. But he will emphasize the fact that the man he takes into the corporation when a fresh graduate from college cannot accept responsibility and that his training has almost been a detriment in so far as industry is concerned.

It has been my good fortune to make a study of industry across the United States and to talk industrial waste and educational waste in industry with more than 275 of the largest employers of men. The average opinion of college men is the same. All agree, however, that the college man holds the key to the situation, that it is his problem upon entering industry to stop the leaks, to increase production, to decrease cost and to stabilize industry. How is he going to do it?

Industry Looks to the Colleges

In the face of almost universal criticism, industry yet looks to the college for the solution of its problems. Industry, with its keen, practical eye, sees farther than the mere lad who comes to its door to gain a livelihood; industry looks to the future. The great capitalist of today who studies the balance sheets sees that the educational waste in industry must stop, and in stopping that waste the very waste in management is terminated. The captain of industry knows that 12,000 men each year leave the colleges and enroll in industry with no previous training to equip them for life in industry; he knows that it takes two years to train those men in the plant at a cost of $2,500 each and he knows that forces today are at work to stop these losses. Industry is interested in the project which has for its purpose the training of these thousands in the college, is grappling with the problem of the undergraduate to save the boy years of work and to save industry 24,000 years each year and millions of dollars in money.

A Movement to Bring the College and the Industry Together

I have the honor to be the chairman of the Council of Management Education, which is dedicated to the work of eliminating this frightful waste in industry and the college. No one is to blame for the mistakes of the past, but, thank God, we are seeing light today. The difficulty has been that industry and the college spoke two languages, two tongues which neither could speak or comprehend. Industry wanted the college to help, the college wanted to help; but both were in the position of a French manufacturer who would do business in America with French measurements and language, both of which the American manufacturer could not understand.

Slowly through the years a movement has been on foot to bring the colleges and industry together. The greatest step was made during the war. We had gathered around us in Washington the leading men of industry and the leaders in the college world. They worked, planned, dreamed together and when the armistice was signed some of these men decided that the great advance should not be lost. A survey of the entire country followed. This was made through the Technology Clubs Associated, and from this body of war workers and growing out of a conference held in Drexel Institute, Philadelphia, in March, 1920, of those most vitally concerned, the Council of Management Education has come.

The Work of the Council of Management Education

Today the Council is backed by industries having a combined capital of $23,000,000,000. Sixteen basic industries are in the movement and a number of others desire admittance as soon as the Council can undertake additional work. The colleges of the country, through the American Council of Education, which has appointed a group of educators to co-operate with us, are working in the closest accord. The majority of the colleges have written independently and offered their entire services. The Governors of every State in the Union save four have appointed representatives to act with the Council.

Thus, industry and the colleges are "getting together." It is an earnest effort to form a central body to consider the problems of each for the benefit of each. It is a non-profit-making body of the highest academic standing and its work is for public service alone.

A Clearing House Between the Industries and the Colleges

As a great clearing house between the industries and colleges of the country it studies the problems of the firm which needs chemists, engineers, men versed in any particular line and, in turn, it studies the problem of the college to supply the men. It is a problem of industrial demand and educational supply. The men in the Council speak the language of the industry and of the college; each holds a major professorship in one of the leading universities and each has had his turn in cold, practical industry. Men of this type alone can take the facts of industry and college and make them available to both.

Eliminate waste—waste in the chemical industry, iron, cotton, rubber—the Council of Management Education has dedicated itself to this task as a service to mankind. I may add that it has been the good fortune of the Council to include several of the nation's greatest chemists in its roll. We earnestly ask the co-operation of all industries and hope the readers of Chemical & Metallurgical Engineering will assist the Council in its great task of service.

Drexel Building,
Philadelphia, Pa.

The Role of Research in Waste Elimination

Encouragement of Fundamental Research in America Is More Urgently Needed Than Stimulation of Industrial Research—Fallacy of Curtailing Research and Disrupting Organization in Times of Industrial Depression—Examples of Waste Eliminated by Research

BY HARRISON E. HOWE
National Research Council

FOR the purposes of this discussion waste may be defined as materials, time or labor unnecessarily used in industrial operations and as finished products which fail to measure up to standards set for first quality in any given field. We may also include under waste values delivered in excess of requirements, but we shall not consider the profitable utilization of otherwise waste byproducts of industrial operations, for that subject, while never exhausted, has frequently been presented in convincing style. It is because most people think only of byproduct utilization when research is mentioned in connection with the elimination of waste in industry that there may be some justification for this article.

While the application of the results of research frequently presents a new problem as difficult as the original investigation, it is not to be confused with fundamental research. There are still many productive scientists, especially among the various kinds of engineers, who classify difficult development or control work with true research, and who are a little prone to think that real accomplishment is theirs rather than the theorist's. And yet we all know, if we will but pause to consider, that our work if sound must be based on the laws, principles and theories developed and established through research on real fundamentals usually many years before their practical application.

Need for More Fundamental Research

There is far more need to encourage fundamental research in America than to stimulate industrial research, notwithstanding the fact that many industries are not yet founded upon a science. A number of great industrial laboratories have shown their appreciation of this by taking up such work and others have made substantial contributions to educational institutions and organizations striving to encourage such research, that more may be accomplished. President Nichols of Technology in his inaugural address calls attention to the fact that we have about exhausted the store of knowledge which has been hundreds of years in accumulating and that we must have new facts in order to make greater progress. While we may not be in immediate danger, the time may soon come when several lines of industrial development will be hindered awaiting the completion of research just as were the sciences dependent upon optical instruments before Abbe's plea for improved optical glass, without which his dreams could not come true.

Fallacy to Curtail Research in Hard Times

With this state of affairs, why will industry consent so readily to the curtailment of research when soft times pass? This policy leads to one of our serious industrial wastes. It has been surprising to find how many firms have made what seems the mistake of breaking up laboratory organizations even to the point of losing men of long terms of service. Such industrial retardation as that through which we are passing offers an excellent opportunity to weed out undesirable or inefficient workers, but it is not the time to dispense with valuable men. As it is, the present really offers to the courageous the chance to build up a strong laboratory organization and the time to engage upon problems which must be put aside in busier times. It is a pleasure to point to those concerns which firmly believe in research as their most potent anchor. These have undertaken research convinced that it will not only enable the elimination of waste to the point where costs will be much lower but that quality will be so improved as to enable the market to be held in the face of poor business and lead customers to discard competitors' wares first when purchases are curtailed. This faith has been justified, and such manufacturers have retained their staffs in the laboratory.

Ideas grow rusty as does machinery. It is not easy to pick up the problem just where it was shelved when the laboratory was closed. Recently a company which had established a research laboratory a year or two ago decided to close it and disband the staff. Something like $100,000 had been spent and some of the problems were nearing completion. What possibility has that company to realize a return on the money spent? The problems were either unfortunately chosen or the work upon them poorly managed or a blunder has been made in stopping work. Research cannot be profitable unless well managed and adequately supported for sufficient periods of time and unless several well-chosen problems are in hand. Every problem cannot be a winner, and allowance must be made for the disappointing ones.

Unnecessary Production of Seconds

The unnecessary production of seconds is an important industrial waste and usually indicates a lack of proper control of raw materials or of the process. Goods sold as first quality which in use prove to be second quality are even worse. Before materials can be so managed as to give a high percentage of first-quality product, research may be required to determine why reactions go the way they do. The more we know the why of what takes place, the better can we govern the procedure. While we still lose much from unsound castings, just recall the state of the art before research showed the beneficial use of metal scavengers and provided the considerable list of deoxidizers from which the foundry may now choose according to its needs. Some of these materials produce such vigorous reactions as to raise the temperature of the metal, thus serving to bring cold baths to the proper pouring temperature.

Research has not only provided improved pyrometers

but has shown many industries how to use them. It has been found that the relatively few degrees between estimated and real temperature often account for second-grade or useless products. It has been difficult for the research man to convince the others of the importance of a few degrees of heat. The failure to check the accuracy of the pyrometer is an illustration. On one occasion this meant the rejection of 70 per cent or more of a small heat-treated steel part. After trying everything else a research man was called. He checked the pyrometer first, found the error and soon after had the plant on a basis where 95 per cent of the product passed as first grade.

Checking Automatic Instruments

In many industries waste has been eliminated by the installation of scientific instruments designed for automatic measurement or control. But instruments wear or get out of order and need occasional inspection. There is the case of a gas company which was operating at a loss. It was a chemical engineer who found that its meters were incorrect, and the simple process of correcting the meter turned a loss of fifteen cents per thousand cubic feet into a profit of as much or more. Recording pyrometers have done much in eliminating waste, for they assist in the standardization of processes in accordance with best practice and enable mismanagement of apparatus to be detected easily. Apparatus for automatically analyzing flue gases and recording the content of carbon dioxide has provided checks on firing-room practice that has saved quantities of fuel. More recently a new type of indicator for high-speed internal combustion engines has been developed in the research laboratory, and by means of this device it is not only possible more accurately to determine the performance of the motor but to obtain more power through an adjustment of timing, etc., precise to a degree not previously attainable. With millions of internal combustion engines in use the elimination of waste accompanying a small increase in efficiency becomes very important. A 30 per cent increase has been attained in several instances with the aid of this indicator.

Research Aided Transcontinental Telephone

When it became desirable to talk across our continent there were those who thought the only possibility lay in reconstructing all the telephones then in use and providing them with new transmitting equipment. This would have cost a huge sum and would have entailed extensive waste in discarding otherwise useful parts. Research prevented such waste by devising the audion and the amplifier. These instruments enable masses of energy to be controlled by a few electrons so that sound waves may be strengthened and magnified without changing their characteristics. Energy may thus be brought in to make up for losses and to balance the lines. This is one of the reasons why long-distance telephony is often more satisfactory than local calls and why millions of telephones without change in themselves had their radius of usefulness increased enormously. Research made unnecessary expenditure which would have been many times the cost of this research.

Now we are about to see another step taken in the installation in many of our largest cities of the automatic telephone, heretofore used principally in smaller places. This does involve replacement of plant and equipment to a large extent, but it will be a saving through better efficiency and reduced cost of operation. Waste often ensues in a plant due to reluctance to replace antiquated equipment when new machinery, etc., has been developed to the point of effecting large savings in time or labor. Indeed, many plants contribute to waste because of poor layout and improper equipment which is used rather than undertake the first cost involved in putting the plant on a sound basis.

Restoration of Crippled Interned German Ships

When the German fleet in American waters was crippled by its crews they were under the impression that they had wasted or destroyed a vast amount of property at a time when it was most valuable. For some years research had been devoted to welding—gas, thermit, electric. With many problems still unsolved, the art has made substantial progress and in record time—a tenth that allowed by the wreckers—the ships had been repaired and a waste eliminated.

Improvements in Electroplating

Electrodeposition of metals has been a potent factor in waste elimination. Research has shown how electroplating can be used to bring a part up to dimensions or weight and save it from the scrap heap. Examples are common in which electroplating enables a cheap metal to serve in place of a more expensive one. This is not only true where it is a matter of color or finish but where durability is the factor. Recently a method has been perfected whereby a plate for engraving can be so built up as to have a surface harder than steel, and more durable. As one master plate serves for the production of a number of plates for the presses, the possible saving is obvious.

Elimination of Corrosion

Waste due to corrosion is as extensive as any other, and research is showing the way to its elimination. As a result we now know something of how to remove oxygen from the water in heating systems and plumbing. Where open feed-water heaters are employed most of the oxygen is eliminated and the remainder disappears when the water is caused to flow over steel sheets so placed as to cause the oxygen to combine chemically with the iron of the sheets rather than later with the iron in the pipes. Water so treated has no after-corrosive effect. It has taken time and effort to show that such corrosion is caused by oxygen and not by carbon dioxide or other agents. Zinc plating has been found to be a very efficient base coating to resist many types of corrosion and upon it the desired finish may be built up. The lacquers, the enamels, the acid- and alkali-resisting paints, varnishes, vitreous enamels, glass linings, improved earthenware and fused quartz indicate what has been accomplished in providing weapons against corrosion.

Research has taken another means of defense against this wasteful agency by the preparation of non-corrosive alloys. Some of these have remarkable properties fitting them for unusual service such as substituting for platinum and offering an opportunity to conserve that precious metal. Others of these alloys have been found of greatest use in cutting metals, as for instance stellite, said to have one and a half times the efficiency of tungsten steel.

These alloy steels have so increased the possible productivity of men and machines that to endeavor to operate without them constitutes an industrial waste.

A given machine equipped with ordinary steel tools can be operated three times as fast if tungsten steel cutting edges are used, which means increased productivity for the machine operator as well.

Determining Specifications for Raw Materials

Resources are wasted in industry when there is failure to employ industrial research in determining specifications for raw materials. Cost alone is never a safe guide and even well-established brands may change at times. Progressive manufacturers now realize that their service departments are incomplete without research men who co-operate with the users of their product in learning their exact requirements. One manufacturer knew that he must use a peculiar paper in a certain type of cable and was in the habit of buying a costly grade from a reliable source. In time research was employed to find just what it was in a paper that the cable required and the result was a saving of $9,000 a year on a pre-war cost basis. The tendency to regard cost as the true index of value in a particular case has often led to waste in the purchase of lubricating oils and further waste in their use, since proper lubrication was not always obtained. Lubrication is still a difficult subject, but there are several scientific factors involved in selecting a proper oil and in many cases the laboratory has found less expensive oils more satisfactory for a given purpose. Without research upon the subject suitable oils could not have been produced, and without research upon their use consumers might be subject to much the same practice as were householders who bought their butter of a man who understood the average unadvised purchaser. He displayed butter at three prices. His sales were almost all from the most expensive. All the butter came from the same tub.

Research on Strength and New Types of Materials

Waste has been eliminated through researches upon the strength of materials. When no accurate data were available it was necessary to have every member of a structure much oversize to be sure it was strong enough. Engineers still employ large factors of safety, but research has provided data from which to calculate specifications. In days gone by it did not make so much difference if a timber was 12 x 12 when 10 x 10 would have been ample, but that is no longer true. It will become increasingly difficult to obtain large timber and because we now know something of the strength of timber of the various species it has been possible to effect larger savings, which will be surpassed by those of the future. What is true of wood is also true of most other building materials.

Research must also be credited with new types of structural materials which, because of their strength, elasticity and other desirable qualities, can perform heavy duty even in small cross-section and thus reduce weight, which means saving power. Vanadium steel will serve as an illustration. It has done its share in making possible the very serviceable light-weight car; while its machining qualities are such as to make a given finished part cost about one-third the cost of the same part from, say, a high-carbon steel which would have the same strength but which is machined with great difficulty and requires much grinding. As research increases our knowledge of the properties of pure metals and their alloys we will be in an ever better position to eliminate industrial waste, for we shall be better able to make alloys for each particular purpose and perhaps embody in them qualities which will mean still further savings. Core loss in electrical machinery is a case in point.

Improvement in Boxing and Packing

It has been estimated that more than $55,000,000 is claimed annually from the common carriers for damage done to goods in transit due almost wholly to imperfect boxing and packing. The opportunity to eliminate this waste has been seized upon and research begun. The factors in the problem include the kinds and thickness of woods and the nailing and strapping of the package in relation to the size and weight of the contents. Crates and fiber containers are included. A standardized drum with scientifically placed baffles and other obstructions is used in these investigations to duplicate the strains and stress to which the package is subjected in transit, and while the work has not been completed, much waste has already been eliminated with the co-operation of shippers who have sent their traffic men and packers to become familiar with these newly established data.

An amount nearly as large represents the yearly waste due to losses in seasoning lumber. This waste comes from a lack of knowledge of the fundamental laws underlying timber drying and our inability to design and operate suitable kilns without such information. Research may be relied upon to secure the data.

Water Softening

There are still many manufacturers who fail to realize what research in water softening has done for them. They continue to waste costly materials in hard water and let their product suffer when the art of water softening has been brought to a very satisfactory stage through research. The more advanced methods for water softening do not involve the use of chemicals from which there might remain residues deleterious to fabrics, etc., and from the commercial softeners development is now turning to the domestic needs. Many textile mills use literally thousands of pounds of soap for water softening without appreciating the fact, and laundries add substantially to this waste.

New Types of Illumination Due to Research

When the statement is made that the country's annual electric light bill would be $400,000,000 greater if carbon lamps were used today in place of the latest forms of incandescent lamps, only a part of the story is told. To eliminate such an unnecessary expenditure is important indeed, but while the new types of illumination have given more light for our dollar they have also given a quality of light which has made possible a class of work in the absence of daylight that has greatly extended productivity. Present-day lighting is such that practically any plant can go upon a 24-hr. day if conditions maks it advisable. It has its effect on office as well as plant, and where costs are high the architect no longer hesitates to count as useful rooms into which the sun never shines. Research in ventilation is playing its part in this same problem and will make possible the elimination of waste time through the great vehicular tunnel which is to connect New York City with the mainland.

But there is another phase of the illumination question.* Even the most improved devices must be properly used. That has been and still is a problem for

research. We have been shown how to place lighting units, the proper use of reflecting surfaces and the most advantageous colors.

Wood Treatment

Research is often called in hurriedly to stop waste and loss. The call is too frequently postponed until the last moment, with fatal results to the enterprise or industry. The damage which marine borers can do has been known for a long time and various treatments for piles have been devised with a view to proofing them against the attacks of these destructive mollusks. It was recorded that marine borers thrive only when the saline content of the water is ten or more grains per gallon. A year or two ago due to drought the level of the rivers emptying into San Francisco Bay fell and salt water in greater concentration than usual entered these streams. Within the year the borer adjusted himself to the new conditions. He fell to work and caused nearly $20,000,000 worth of damage to marine structures. Piles that had been treated were cut off in a few months. Others treated in the same way endured. Many odd relationships developed. The stake for which research fights the tiny mollusk is large indeed and the scientists are organizing their work to include biology, chemistry and engineering. The problem will be broken up into its several phases and these solved. In time from his work will come fundamental principles and, following these, methods for so building our extensive marine structures as to make them reasonably permanent.

Methanol, a Promising Field

Methanol is an important solvent. So far nothing has been found really to take its place and its only source is the destructive distillation of wood. This must be hardwood. Any device for increasing the yield of methanol becomes more and more important as our hardwood supplies are used. Research may show the way to synthetic methanol. It has already been found how to increase the yield 15 per cent without increasing laboratory costs. The laboratory work indicates that by the use of an inexpensive chemical it may be possible to get an increase of 50 per cent in yield. Anything less than the maximum yield naturally gives rise to an industrial waste. The waste in use of this and other solvents is being prevented by solvent recovery according to methods devised in the research laboratory.

Time and Material Conserved by Research

The conservation of time and material effected by research is just another way of saying that even though prices seem high at times we would not enjoy what we have but for the savings made and the waste thus eliminated. A five-cent piece could not buy a telephone call today but for research, and it would cost more to finish your automobile but for the same agency. Spray systems are quite satisfactory for much painting and finishing work, while modern drying systems permit solvent recovery and temperature control, which are important factors in lowering first cost and insuring satisfactory work.

By the application of the centrifugal clarifier to the varnish industry, rejections of finished materials have been reduced from 50 to 5 per cent and there has been a saving of 80 per cent in labor plus the elimination of much material waste.

It would be difficult to make even a rational guess as to the horse power that has been saved through the use of ball and roller bearing developed in recent years for shafting, heavy machinery, and in many installations requiring continuous duty.

The increase in available horse power per pound of coal via the steam turbine may be properly credited to research. Without question waste will be eliminated in our highway construction as a result of research now under way.

In fact, whatever the field of endeavor, research has effected elimination of waste, and no doubt still greater savings can be made by its continued application. It is certain that waste cannot be eliminated unless we know just where, how and why it occurs. There is no sure way of knowing these things unless we call in research. In the past the most important wastes have been found where least suspected and more waste will be eliminated when our industrialists come to know research better.

Washington, D. C.

Waste Due to Interrupted Production

The amount of idleness or unemployment in industry can be evaluated only through rough estimates. The Committee on Elimination of Waste in Industry stated in its report (July, 1921) that in the best years, even the phenomenal years of 1917 and 1918 at the climax of war-time industrial activities, when plants were working to capacity and when unemployment reached its lowest point in twenty years, there was a margin of unemployment amounting to more than a million men. This margin is fairly permanent; seemingly one or more wage earners out of every forty are always out of work. This unemployment means for the worker a loss in wages, for industry increased overhead due to idle equipment and idle materials, and for the public lessened purchasing power, with all its attendant evils.

During periods of industrial and business depressions unemployment reaches its greatest amount. Such depressions appear more or less regularly at seven or ten year periods and each brings its increase in unemployment and wastage of the productive capacity of industry.

In January, 1921, a nation-wide survey of employment made by the U. S. Employment Service of the Department of Labor showed that there were 6,070,648 workers then employed in industry, as compared with 9,402,000 in January of 1920, a decrease of 3,331,352 or approximately 35.5 per cent.

In addition to minimum and climacteric unemployment, many essential industries show a high unemployment or idleness once a year or oftener. Practically all industries are in a sense seasonal.

Not only does intermittent unemployment reduce the productive capacity of the industry in which it exists, but it brings other wastes. One consequence is a concrete but fallacious industrial philosophy, the "make work" or "lump of work" theory. This is the belief that there is only so much work to be done and that the sensible course of action is to retard production to make employment last throughout the year, or to uphold prices.

Another form of unemployment comes from open conflict between management and labor. Here it should be said that in the past, at least, the amount of waste from the general run of strikes and lockouts through loss of wages and curtailment of production has been less than is popularly supposed.

Waste Due to Lack of Standardization of Chemicals

Careful Standardization of Chemical Products Will Result in Eliminating Misunderstandings Between Buyer and Seller, Will Reduce the Diversity of Products to the Ultimate Advantage of the Consumer and Will Facilitate National and International Trade in Chemicals

By WALLACE P. COHOE
Consulting Chemical Engineer

AS A DIAGNOSTICIAN of sick processes the consulting chemist often finds that loss of production, waste of material and failure to maintain standards of quality in finished products are quite as frequently due to a lax supervision of the raw materials entering into a process as they are to carelessness in the actual manufacturing process itself. Processes which have been running along quietly for years often do get "sick." This may happen suddenly without warning. Hydrogen peroxide becomes effervescent, potassium iodide goes yellow or will not crystallize properly, an azo color goes off shade badly, cotton piece goods will not fill properly, a previously steady-going evaporator suddenly bumps and primes, the lacquer on polished brass peels and flakes, a causticizer will not settle properly and its contents will not filter satisfactorily.

In every plant something of this character happens from time to time. When this does occur, the workman in charge is likely to report to old Bill, the foreman, "Bill, I can't get her up to strength, she ain't going right." To this old Bill is likely to retort, "It's that there new stuff the purchasing agent got last. Get some of the old stuff." But the former material is all used up and they sit up at nights trying to get the process back to normal. Production and quality both drop, so old Bill goes to the superintendent with his troubles. "Say, boss, my department is on the kibosh. That there new stuff oughtn't never to have came into the place."

Use and Abuse of "Specifications"

The superintendent, knowing that many a shrewd idea may hide behind a misused past participle, decides to investigate and checks his specification on the material from the new source, finding that it should give no trouble. He has the laboratory check the former analyses, but no clue to the mystery is found. If there is no plant laboratory, much heated correspondence ensues between the purchasing department and the makers of the product under question.

In the meantime "old Bill" back in the plant is in worse trouble than ever. He cannot get any production worth mentioning and the shipping department is hounding him. It is time for a general inquest. Possibly an outsider has to be called in. It is unnecessary to go into the details of that inquest. We have all attended many. The verdict in the actual case I have in mind did not condemn the new material, but laid the blame upon a too high percentage of iron in one of the heavy chemicals used in the process. This heavy chemical had been purchased for years from the same manufacturer, but a new shipment had not been up to the usual standard. This lapse in quality, in this case by loss of material, loss of customers and expense of investigation, not only ate up the profits of a department for a considerable period but caused a loss of confidence in the minds of the selling staff, who naturally disliked the task of explaining to dissatisfied customers.

"But," my critic will retort, "that plant just mentioned was not run properly. Now, in our plant that tank car of blankety blank would have been tested as soon as it was spotted and if not up to specification——." "Specification," that is the word.

It is a fact that where business is properly operated today it does buy and use materials which must come up to a definite specification before they are put into process. The extent to which this practice is carried out is an indication of how far a manufacturer has progressed beyond the rule-of-thumb stage. Some manufacturers buy upon a good specification and leave the matter there, trusting to the manufacturer of the raw material to maintain a specification set forth in the buying contract. This is a dangerous practice and is productive of many losses. Not only must raw materials be bought upon specification, but in this present day when mistakes do occur in spite of most honest intentions, it is necessary thoroughly to examine goods delivered in order to know whether they meet the contract specification.

Need of Standardized Specifications

While it is generally admitted that specifications are common in the buying and selling of chemicals, it may also be truly said that standardization is not general. "But," a manufacturer may say, "why should we worry about standardization if our customers are satisfied with the goods they buy upon specifications which are drawn up to suit their own individual needs?" This point of view is natural, nor is it unreasonable when an industry is in an infant stage and consequently at a time when standardizations are difficult to formulate. If the chemical industry be still an infant industry struggling to find itself, then it is unwise to talk of standardization. Our industry, however, has, we think, emerged from its swaddling clothes, and, if it be not yet a full-grown man, it is at least a hardy stripling, old enough to play the game according to rules.

Advantages of Standardizing Specifications

Standards are rules, and rules, like laws, are made not to suit each individual case but rather to yield the greatest good to the greatest number. If a manufacturer of heavy chemicals, for instance, is obliged by his customer to modify his products to suit the individual needs of each individual purchasing them, the result in the end will be a higher price to be paid by each on account of this diversity of product. There is the apochryphal case of the varnish manufacturer who advertised and sold to his customers varnishes which

ran from spar varnish to cheap furniture varnish, all of which came from the same tank in his warehouse. A chemical manufacturer, even if he wished to do something like this, could not, because he is continually being checked by his customer. Is it not possible, however, by careful standardization to reduce the diversity of products to the ultimate advantage of the consumer?

Standardization Leads to Better Business

Let us examine some of the reasons why standardization makes for better business. Disagreements in business between reasonable men—and the majority of folks in this world are reasonable—usually take place because the two parties to an agreement are not talking about the same thing. A disagreement usually takes place by steps. First, there is moderate protest, then active discussion, upon which follows mutual recriminations and often finally litigation. Both parties are honest; the seller has delivered so much of a certain commodity described in a phrase, while the buyer has received so much of the same commodity, but the meaning of the phrase describing the merchandise in the mind of the seller does not convey the same idea to the mind of the buyer. In other industries this condition has led to the formation of a number of standards. For instance: a fruit grower in western New York may send a consignment of "No. 2 Northern Spy Apples" to England and both he and his English customer understand what the phrase "No. 2 Apples" means.

Misunderstandings Resultng From Lack of Standardized Grades of Chemicals

Up to within the last few years in America the bulk of trading in chemicals has been between the manufacturer of them and another manufacturer who uses them in his own process. Our advent into the larger world trade during the war led to a widening of the field of trading in chemicals. Chemical brokers bought large quantities of chemicals from manufacturers, which they in turn might ship, for instance, to South America or the Far East. A banker in the meantime might be asked to lend money upon warehouse receipts. Numerous disputes arose about and fault was found with the quality of the chemicals being traded in. "C," the customer in the Far East, refused to take delivery of the goods which "B," the broker, had purchased from "A," the original manufacturer, while "D," the banker, was often at a loss to know whether or not he had made a loan upon worthless goods. "A," the manufacturer, and "C," the customer in the Far East, probably each knew what he was talking about. "B," the broker, and "D," the banker, had not this knowledge. If, however, there were available standard specifications describing chemical products, such difficulties as these, which are really encountered in trading and banking, would become reduced to a reasonable minimum.

Points to Be Considered in the Standardization of Chemicals

If we are to attempt standardization of the common chemicals which are bought and sold daily there are several points which deserve consideration.

In the first place, any stated standards must be reasonable if such standards are to serve the common good. Such standards must avoid the unnecessary refinements which chemists are rather prone to demand in the products of others.

Secondly, such standards should embody as far as possible existing practice and should tend toward the simplification rather than a multiplicity of specifications. An attempt was made some years ago by the American Chemical Society to formulate a set of specifications, but this attempt met with no success. Apparently there is no desire on the part of the manufacturers of heavy chemicals for standard specifications, although these same manufacturers are very strict in their demands upon others. It is most natural that these gentlemen should fear a disturbance of their routine by an attempt to standardize these products, and it is the writer's opinion that the growth of a set of standards should be an evolution.

Thirdly, such a set of standards should be so drawn up as to provide for the average consumer. If any particular consumer must demand a specification more stringent than the average, then it would seem reasonable that he should pay the price for the same without putting a burden upon the majority.

Fourthly, a commercial standard should contain the following:

(*a*) A terse phrase describing the substance.

(*b*) A term accurately setting forth the proportion of the essential material in it.

(*c*) A series of grades, by numbers or letters, which will indicate the percentages of extraneous or harmful substances allowed.

Standardization of Chemical Products Will Facilitate International Trade

We are now at a period when transportation is bringing together the ends of the world, when men widely separated are doing business with one another, and, by the use of standards in many trades, do get along successfully in their commerce with one another. When lumber, wool, cotton, fruit, grain, naval stores and many other things are graded it is unfortunate that in the chemical trade a set of common standards generally agreed to does not exist. Yet we have heard it claimed that chemistry is an exact science.

New York City.

Performance Standardization

The Committee on Elimination of Waste in Industry, Federated American Engineering Societies, in the summary of its report (July, 1921), in dealing with performance standardization states that performance standards should be developed as a valuable aid to planning and production control. Under the week-work system such standards are the basis of a just measurement of the individual worker's performance and of the adjustment of his wage rate to his capacity. Under the piece-rate system they are the basis of just rates. Without standardization of appliances, conditions, work content and method, no valid performance standard can be maintained.

By constantly comparing actual performance with the standards and promptly investigating the causes of the departure from standards, the manufacturer can quickly detect adverse conditions as they creep in, and rectify them. Performance standards, in fact, will enable him to plan the size of his plant and operating force for a given volume of business for continuous operation.

Methods of wage payment should be adopted, equitable and just in their basis, insuring a proper relationship between effort put forth and results achieved by all who participate in the enterprise.

The Personnel Problem: To Eliminate the Waste of Human Effort

Many Wastes of Time and Production Can Be Attributed to Improper Selection and Placement of Personnel and to Management's Failure to Recognize the Value of Training, Transfer and Promotion of Deserving Employees

By L. B. HOPKINS
Treasurer, the Scott Company

TEN girls worked in a payroll department, computing hours worked and earnings. Each week a line of dissatisfied employees formed at the pay window to complain of errors in pay. Then two other girls, older and more capable, were hired to check the work of the ten younger girls. One day one of these two girls was shifted from inspection to the actual figuring of hours and amounts. For the first week she averaged fifty cards an hour. The younger girls averaged thirty cards an hour. The older girl caught her own mistakes. The younger girls didn't. The two older girls got $18 a week, and the younger ones got $15.

The department head did some figuring. The result was that as soon as he could he transferred the ten younger girls, replacing them with the two older girls and four more like them—girls who had a slightly better education and more sense of responsibility in their work. These six girls handled the job that the ten younger girls had been doing and practically eliminated the line of disgruntled employees at the pay window. The result was a direct saving of $78 a week and an indirect saving of a good deal more.

When the manager asked what had been done to reduce the complaints at the pay window he heard this story. He then told it in a meeting of department heads and said: "There are types of work in all departments that demand specific characteristics in those who are to perform those tasks effectively. In this case it is evidently cheaper to employ a higher grade of help than has been the practice in the past, in order to obtain persons qualified for the work. Some of the rest of you may find something of value in this interesting case."

High Labor Turnover Due to Improper Personnel Selection

Twenty-five inspectors of small metal parts were required in a machine department of another company. It was not difficult to get men to take these jobs, but it seemed impossible to keep them. They wouldn't stay. The plant superintendent talked to the foreman about his labor turnover. The foreman defended not only himself but the employment office. He convinced the superintendent that as foreman he was not disagreeable, unjust or overbearing. In fact, the superintendent knew him to be a foreman who could get out work and at the same time hold the good will of his employees. But employees didn't stay on the job. The superintendent questioned the foreman about the selection of employees for that work by the employment office. The foreman replied that the employment office was co-operating 100 per cent, and added: "They're putting a higher grade bunch in there all the time, but they won't stick."

After more study of the causes of turnover in this small parts inspection group it was found that by making the trays smaller and lighter, women could do the work as well as men and that some women would stay on the job. Women who had had a high school education wouldn't stick. They got tired of the everlasting monotony, just as the men had, but women who had had less education and who were nimble fingered frequently liked the work and stayed. After a long period of trial and error, this plant discovered that it is bad business to use too high a grade of help on a job. These are actual cases. They really happened.

Selection of Effective Workers

One might go on telling all sorts of causes of waste in human effort because the man or woman on the job couldn't do it or didn't like it. They happen all the time. They have been happening for years. They are so common that the causes can be grouped and classified and studied, and they have been. In many cases the general principles for effecting a remedy have been worked out and in a number of instances the technique for avoiding specific mistakes has been developed.

Here, for instance, is an important general principle: If your workers are to be effective, they must be adapted for and interested in their work. And a force of effective workers is the surest guarantee against inefficiency and wasted effort that a manager can have.

If accountants could set up an inefficiency account that would show all of the minutes of all of the days that employees don't work because they don't want to, plus all of the time wasted in waiting to be told, or in attempting to do that which they are incapable of doing, it would be a startling amount.

Some managers are shocked when told that such waste is to a considerable extent not only avoidable, but absolutely up to them. To allow such waste to continue unchecked is certainly chargeable to inefficiency of management. It is management's responsibility to provide those means already tried and proved elsewhere for eliminating this cause of waste. Furthermore, management is responsible for developing new methods for conserving time now wasted, through study and research. But what are these means that have been proved through actual tryout?

Analyzing the Requirements of the Job

First of all, it is necessary to know the important requirements of the various jobs. Too often you will hear a job described as one that requires brains, or

guts, or education, or accuracy, or as just a plain-going steady job, or a job where a person must be able to stretch himself when necessary. Frequently an attempt has been made to hit upon the real requirements.

In a New England mill they were hiring persons to learn machine tending who were quick with their fingers. This was a mighty good start, but for a long time they overlooked the fact that short persons couldn't reach to perform some of the operations without standing on a soap box. That is just what the short persons did. After a comparison of output of the two groups—those who used soap boxes and those who didn't—it was evident that length of reach was a factor in success on that job. Simple, you say. Yes, it is, but only after you have recognized that analyzing the requirements of the job means actually finding out what things are needed in individuals to fit them for a particular occupation.

The head of an accounting department complained to the employment office because the handwriting of the new clerks being hired was so poor. The employment office thereafter made applicants copy three or four lines of text onto the application blank. This, they said, gave them a pretty good slant on the applicant's penmanship. It did, but later on it was discovered that many applicants wrote a beautiful hand and at the same time made horrible figures. And in the accounting department the job in question was posting figures day in and day out. Now they request the applicant to copy several numbers of five or six digits each on the application blank, and they know about his ability to make figures before they put him to work on a job where making figures is the chief qualification needed.

Studying and Developing the Sources of Labor Supply

Some jobs require a great deal of the ability to learn and others don't. Some jobs offer a real opportunity to advance, others are out-and-out blind-alley jobs. Unless you can make something more out of your blind-alley jobs, or until you can, it's a mistake, and a wasteful mistake, to put an ambitious person on those jobs. It is just as wasteful to load up positions that bristle with opportunity with persons who haven't the capacity or the desire to go ahead.

With a knowledge of the requirements of the various jobs, the foundation is laid for making wage studies, for developing a promotion program, for establishing training courses and for selecting, placing and transferring employees. Moreover, this knowledge will make it possible to determine whether the applicants for work in your organization are of the right type to supply you with those well suited to the nature of the work in your industry. This is often referred to as "studying and developing your sources of labor supply."

Sally Jones received the following letter one day last spring:

> Dear Miss Jones: We are writing to you because you worked for this company for a year and a half. We want to get in touch with those former employees who, like yourself, were able to handle our work in an intelligent and capable way. You know our organization and the kind of work we do. Do you know of any girls who desire a position that you think would make the right type of employee for us?
>
> If you do, won't you give us their names and addresses, or if you prefer, tell them to come into our employment office for an interview and ask for Mr. Smith?
>
> If you would be interested in obtaining a position with us again at any time, please let us know. We should like to have you back with us.
>
> We want to take on a number of capable girls just as fast as we can make room for them in the organization. Very sincerely yours, Frank Smith,
> Employment Manager.

Fifty of these letters, made personal by a reference to actual dates of employment or to the correct length of service, built up a most desirable source of supply for a Middle Western company at a time when it was exceedingly difficult to get any help at all. Ministers, priests, doctors, lawyers and retail business men will often appreciate being furnished with a supply of little notes of introduction to the employment manager, that they can give to men or women and boys or girls who desire positions. These and other methods can be used almost anywhere to build up a desirable supply of labor from which selection can be made for positions as they become open in the organization.

Value of Modern Employment Methods

The selection of the right persons for your type of work is again not a matter of sleight-of-hand, but involves only the use of quite ordinary and commonsense methods. Nobody is capable of making perfect selections. There isn't any way known of discovering beforehand all that one might want to know about a person who is to be hired. There are men who can avoid a great many of the mistakes that are being made every day in numberless plants and stores and offices where modern employment methods are not in use. These men who can avoid the more common mistakes are not gifted with the power to read minds or any other supernatural power, but they do know the methods needed in employment work and how to use them.

A bright-faced fellow seventeen years old walked into the office of such an employment man a few months ago and asked for a chance in the drafting department. He wanted to learn drafting, he said. The employment office interviewer knew of such an opening and thought he might find in this healthy and hearty youngster a good apprentice for the drafting department.

In the interview it developed that the boy's father was dead and that the boy was carrying out his mother's wishes in trying for a chance to take up drafting. It certainly was to his credit that he wanted to do what his mother wished. The next question brought out the fact that he knew nothing about drafting and had not thought of it until his mother suggested it. His school record raised a doubt as to his qualifications for the drafting room, however, for he had just finished the eighth grade at sixteen and had not moved or had a long sickness during the school period. It at least raised the question as to why he was two years longer in completing eight years of schooling than the normal boy would have been. In a test for alertness, he did rather poorly and he was very poor on the arithmetic questions in the test. The boy was asked to come back the next day. Meanwhile the interviewer 'phoned the boy's teacher and learned that he had always had trouble with mathematics. She added that she couldn't understand his case at all, that he was a good boy, though lively, that he tried hard, she knew, and that everybody liked him that ever met him.

The next day the boy was given a chance, not in the drafting apprentice course, but in the merchandise department. Already his sales are equal to those of some

older men in the department and his personality is adding daily to his own and the company's "good will" in the community. He likes the job and is interested in it.

Selecting Skilled Labor and Technical Experts

The selection and placement of skilled labor, retail sales persons, experts in accounting, engineering, chemistry, etc., and professional men offers comparatively little difficulty in picking men qualified for the positions to be filled. Their previous training and experience, their education and achievements are a matter of record that can be easily obtained and checked. The most common error in the placement of such specialists is the all too frequent assumption that a man with an exceptionally good record in his special field will of necessity make a success in another field. A very capable physician may be quite incapable of administering a medical department in industry. A skilled machinist is not qualified, because of that fact alone, to be a foreman. The best chemist in the organization would quite possibly make a mess of the job of office manager.

In this fact lies another important principle of personnel work. Because a man has succeeded in one type of work you have no right to assume that he will succeed in any other situation demanding quite different qualities and abilities.

Let's take your family physician and consider his qualifications for a supervisory position in your business organization. It is to be presumed that you have confidence in his knowledge of medicine, since he is still your family physician. How well is he adapted, as you know him, for the position of department head? Here are some of the qualities which the position of department head demands. How would you rate him in each of these qualities?

Rating a Department Head

I. Consider his success in winning confidence and respect through his personality.

II. Consider his success in doing things in new and better ways and in adapting improved methods to his own work.

III. Consider his success in winning the co-operation of men, in welding them into a loyal and effective working unit.

IV. Consider his success in organizing the work of a department, both by delegating authority wisely and by making certain that results are achieved.

V. Consider his success in making his department a smooth running part of the whole organization; his knowledge and appreciation of the problems of other departments.

VI. Consider his success in improving men by imparting information, creating interest, developing talent and arousing ambition.

VII. Consider his success in applying specialized knowledge in his particular field, whether by his own knowledge of ways and means or through his use of sources of information.

It will be interesting, for purposes of comparison, to pick a man from your own organization whom you consider to be very successful in running his department and judge him in terms of these same qualities. It may be that you will find that some of these seven qualities are not particularly well adapted to the requirements of executives and supervisors in your organization. They were prepared to cover the essential qualities in a specific case, but you can substitute wherever necessary and still discover from actual tryout that even exceptionally capable individuals differ in their abilities and that while they are without question successful in one field, they might be totally unqualified for another.

Transfer and Promotion of Employees

It is just as important to recognize that those individuals who have failed in the specific task to which they have been assigned may be assigned to different work and succeed. It has been and still is true that considerable waste is incurred in many organizations by dismissing from the organization men who have fallen down on some specific task. Frequently such men could have been placed elsewhere in positions for which they were fitted, had anybody taken the trouble to discover in what these men were interested and for what their training and experience fitted them.

The management that recognizes its employees as individuals, with different individual abilities, and that endeavors to find the right position for the individual who has been unfortunately placed is developing a type of loyalty and good will in the organization that no amount of propaganda and profit-sharing will obtain. The transferring of employees should not be limited, however, to those who are not getting along well in their present positions. The greatest incentive that can be established for conscientious, effective, whole-hearted service is found in the policy that establishes the principle of promotion within the organization and in the management that sees to it that this principle is put into practice.

This practice is not only an opportunity for management to build up an effective organization, but it is also management's responsibility to the workers, to the community and to the owners of the business. Nor does management's responsibility cease when it has made possible the recognition and promotion of those employees who by their own efforts have succeeded in fitting themselves for greater responsibilities. If it is the policy of the company to obtain intelligent, capable, ambitious employees for those positions where these qualities are needed, then the company should offer the opportunity for these persons to receive training that will fit them to go ahead.

Proper Training of Employees

Many companies have recognized this responsibility and are conscious of the advantages that accrue from training courses. Because of the pressure of other work and a lack of serious thought on the subject, it too often happens that a most unfortunate waste creeps into the whole training program. This sometimes occurs through the misdirected effort of an overzealous director of training, who enlists as large a number of students as he can, regardless of their capacity to learn or their adaptability to the courses in which they are registered.

Some months ago a manager asked a consultant of his acquaintance to look over the office boy situation in his company. Two of the cases covered in the report are of interest and to a considerable extent are related to that manager's training problems.

Case 1. "Joseph Decker is now fifteen years old. He quit school at fourteen years of age, in the sixth

grade. This suggests that he had difficulty in doing elementary school work. He scored very low in the intelligence tests. The indications are that this boy's mental capacities are limited. He has been urged, however, to take the bookkeeping course and is really attempting to swing it, without much success. Here is an indication that the boy is ambitious and would like to fit himself for more responsible work. The important question is: Are his capacities too limited to enable him to succeed in this work? If so, then it would be wise to transfer him. He is mechanically inclined and interested in the assembly operations in the plant. His interest might be elicited and the opportunity offered him in a suitable training course and a transfer effected to an operating department."

Case 2. "William Brennan is now sixteen years of age. He quit school at thirteen years of age, having completed the eighth grade. He obtained a very high score in the intelligence tests. His schooling and his test score and his service record with the company indicate that he is bright. He is taking a course, on his own initiative, in mechanical drawing, in a night school. He has been an office boy here for a year and a half. It might be desirable to transfer this boy to the engineering and test department, where he could come in closer touch with the company's drafting work."

Wastes Due to Misfits in Supervisory Positions

In another company a similar investigation was made of the foremen, assistant foremen and supervisors. There were numerous cases found of men who had been excellent workers. Some had been lifted out of work where they were making a real success into supervisory positions for which they were not fitted. Such positions should have been reserved for men qualified to grow into assistant foremanship and foremanship duties and responsibilities. These misfits as supervisors were, however, persuaded to take the foreman's training courses and in some cases they had never mastered the common school work of the seventh and eighth grades.

When you have misfits in supervisory positions, the waste that results from wrong placement is multiplied all along the line. A poor supervisor wastes the time of his superintendent. He wastes the time of his associates. He wastes the time of his workers and frequently this holds up the work of other workers all through the organization.

All of the principles that govern correct personnel work for the rank and file of the workers are applicable in maintaining the executive and supervisory force.

The source of supply for foremen and department heads demands careful study and cultivation. The selection, placement, transfer, promotion and training of these representatives of management all offer a means for keeping the morale of the organization up and the waste of human effort down. If the worker is to be effective in his work, his foreman or department head must certainly be adapted for and interested in his job. And like the worker, those who direct the work of others are themselves entitled to the assurance that their manager will interest himself in their opportunities, their capacities and their desires.

This then is the personnel problem: to develop and co-ordinate the opportunities, capacities and desires of people at work. In the solution of this problem lies, in a great measure, the solution of the problem of reducing the scrap pile of waste time in industry.

Philadelphia, Pa.

Waste Due to Restricted Production

Waste due to restricted production has been analyzed by the Committee on Elimination of Waste in Industry, and the following is an abstract from the summary of its report (July, 1921):

Restriction of individual output for which workers are responsible are susceptible of measurement. They are of two kinds. On the one hand, when workers are scarce the less conscientious workers become independent and slacken speed, whereas when workers are plentiful, they work with greater diligence and care for fear of unemployment. On the other hand, the dread of unemployment is so pronounced that employees engaged in seasonal enterprises frequently restrict production in order to make employment last longer; some workers, moreover, through consideration of their fellow employees limit production to provide work for them, a practice which ultimately results in an economic loss.

Important restrictions of output by employees can result only from collective action. In the building trades, for instance, some painters' unions do not permit of the use of a brush wider than 4½ in. for oil paint, although for certain classes of work a wider brush is more economical.

The tools of the engineer are standard weights and measures, scientifically established. He cannot serve industry unless he can set standards for production and can measure work performed. Many unions now oppose the use of such standards.

Unions are charged with restricting the use of machinery. Painters' unions refuse to allow their men to work on a job where a spraying machine is being used, making claim that the use of the machine is injurious to the health of the workman.

All such restrictions, so far as they prohibit the use of the best and most efficient machine, constitute limitations of output. The actions of most unions, however, are confined to the restriction of the use of machinery rather than its prohibition.

Relation Between Management and Workers

Management has a definite responsibility in selecting, upgrading and maintaining personnel.

Experience indicates that the best results can be obtained when employment and personnel direction develops a sense of mutual interest in production on the part of management and workers. To accomplish this management should stimulate the interest of workers, individually and collectively, in creation, in craftsmanship and in the contribution of their experience and knowledge to the productive processes. "Industrial relations" to be effective should be closely allied to production and concern itself with educating the workman in the science of process, recording his accomplishment and enabling him to become conscious of the relationship of his work to the whole.

During the past few years there has been a widespread advance in extension of employment and personnel methods in industry and many of the accruing advantages are now generally known. Among these is a means whereby the worker has a direct avenue of approach to his employer, and the employer has a means for communicating organization policies to the employee. Such industrial education and training as has been conducted by certain leading manufacturers has obtained beneficial results, and it is believed that further developments along these lines is desirable.

Disclosing Waste Through Better Cost Methods

Many Industrial Failures Are Traceable to Blind Dependence on Cost Determined by Rule-of-Thumb Methods—Modern Cost Systems Will Disclose Waste in Unprofitable Products, Idle Labor and Machinery and Erroneous Methods

By ERNEST J. WESSEN
Industrial Engineer, W. T. Rawleigh Company

IT IS scarcely necessary to urge the need of accurate cost determination. If the voluminous literature which has been dedicated to this subject, the hundreds of articles which have appeared in technical journals, pages of advertising, to say nothing of the pretty little pamphlets brought with each mail, have not educated the industrial executive to the real need for accurate cost knowledge, then certainly existent economic conditions have.

The progressive manufacturer keenly realizes that if he is to survive the coming aggressive and intensive competitive era, he must not only know what his product costs him, but—of more importance—he must have such control over his manufacturing operations as will enable him to keep his costs at minimum levels. Without a comprehensive knowledge of his costs, he will be unable intelligently to compete with those who have provided adequate cost control, and must inevitably meet defeat at the hands of his progressive competitors. It is scarcely possible to overstate the case in urging the need for cost knowledge.

Value of Detailed Manufacturing Costs

The value of accurate detailed manufacturing costs may be divided into two phases: First, the commercial value arising from the necessity of having an accurate knowledge of costs in order that selling prices may be intelligently fixed. Second, the technical value to the management in placing at its disposal pertinent cost data enabling the manufacturing executive to establish proper control over manufacturing operations. The greatest value of cost information to industry is its technical value.

It is not impossible or indeed extremely difficult for manufacturers to approximate closely the cost of the finished article by rule-of-thumb methods. In fact, if he is painstaking, his results may be startlingly close to those obtained by more complex methods. However, this is the exception rather than the rule. A large percentage of industrial failures due to managerial incompetence can be traced to blind dependence on costs arrived at through antiquated rule-of-thumb methods.

Granted that we arrive at exceedingly accurate costs of finished products by rule-of-thumb methods of estimation, this is of no avail if we lack sufficient control over our manufacturing operations to enable us to meet our competitors' prices. Indeed, few healthy, industrial executives are satisfied with trailing their competitors; most of them prefer to take the lead. The lead cannot be taken and held without manufacturing control, and manufacturing control cannot be established without detailed cost data. Obviously, there is only one way to obtain this information—through a cost system.

The successful cost system must isolate the various elements of factory costs in such a manner as to permit the manager to make a quick and accurate analysis of manufacturing conditions. The figures obtained must be of a current rather than of a historical nature. In other words, the results must be compiled and placed in the hands of the executive in ample time to permit the establishment of positive control over current operations. The progressive manager is not concerned in what has been done, but in that which is being done. The system must further provide for the establishment of cost standards by which subsequent costs may be controlled.

Such a system will disclose unprofitable products, waste, idle machinery, idle labor and erroneous methods. It will enable the management to formulate policies and assist in successfully carrying out such policies. Standardized costs will be established, comparative economy of operations ascertained. It will be possible to place the factory on a budget basis. Selling prices may be fixed with confidence—in fact, profits practically assured under normal conditions. Indeed, once such figures have been made available they become indispensable.

System Should Be Simple

The efficient cost system is as simple as is consistent with sound manufacturing practice; all frills are eliminated. Its operating cost is extremely low as compared to the returns received; hence it is productive. Cost figures are sufficiently detailed as to render intelligent deduction practical, but not in too great detail. Extremely elaborate analysis of cost is seldom justified. Cost figures obtained are accurate within the bounds of feasibility. Accuracy in costs must be striven for, but strictly speaking is unattainable. In short, the system must be eminently practical.

It is not a difficult task to install such a system; the expense is not great and the need for it is fully recognized. Despite this the Federal Trade Commission states that out of 250,000 manufacturers in the United States but 12,000 have adopted some sort of a cost system. Ninety-five per cent of our manufacturers facing unknown conditions without a knowledge of their costs, in other words, entering upon uncharted seas without a compass! Clearly this apparently apathetic attitude on the part of American manufacturers must be due to some well-founded cause, especially in the light of the great publicity which this subject has been given.

The cause for this reluctance on the part of manufacturers to adopt modern cost methods is easily found. In the first place the results obtained from the average cost system have not justified the claims made for it at the time the system was sold to the manufacturer.

Many worthless but expensive systems have been foisted upon industry.

Failure of Modern Cost Practice

If we accept all cost systems in operation today as representative applications of modern cost practice, then modern cost practice has failed. There are, of course, many excellent systems in operation, but that the majority of those installed during the past five years have failed is not to be denied. Their failure has been so complete as to arouse doubts in the minds of industrial executives as to the soundness of the fundamental principles upon which these systems were based. In this fact will be found one of the major reasons for the reluctance to adopt modern cost methods.

We shall not undertake to cite here the innumerable ways in which cost systems have failed, in many cases disastrously. It will suffice to say that failures have been so numerous and in some cases so ludicrous as to destroy the confidence of many manufacturers in the judgment of those who are supporting the movement for "better cost methods." That the majority of systems in operation have failed and proved impracticable is not to be denied. However, the failures are not due to inherent defects in fundamentals. Probably another factor tending to further the apathetic attitude of manufacturers has been the apparent incompetence of many of those attempting to further the movement. This latter condition as well as the failures of so many systems can be attributed to nothing other than the conditions existent at the time the movement for manufacturing costs received its greatest impetus.

History of Modern Cost Methods

Probably no other phase of industrial management has been born under such unfavorable conditions as cost finding. Prior to 1917 there were few cost systems in the United States worthy of the name. Here and there would be found a system maintained largely for its commercial value. It was looked upon by most manufacturers as an expensive fad, and at the time we entered the World War cost finding was practically unknown.

After April 6, 1917, and until October of the same year the War Department made practically no attempt to obtain immediate production. According to Benedict Crowell, Assistant Secretary of War, "the department was engaged in determining requirements and formulating plans for mass production." ("America's Munitions.")

In October the department's plans had been formulated and the awarding of contracts began in earnest. During the preparatory period the cost-plus contract had been decided upon as the most equitable basis upon which war material might be obtained. In a few months time the Ordnance Department alone had in force 8,000 of this type of contract, the Signal Corps, with the Aircraft Division, as many more. The Quartermaster Corps Construction Division and other branches also awarded large numbers of these contracts. A conservative estimate would fix the total number of these contracts in effect during the early months of 1918 at 25,000. Many manufacturers had more than one active contract, but it is a safe assumption that these contracts were divided among not less than 15,000 manufacturers.

The accurate determination of manufacturing costs is essential to successful operation under the cost-plus type of contract. The preliminary studies of the War Department had shown the officials that it would be necessary to maintain a large staff of cost accountants to check manufacturing costs under this type of agreement. Accordingly in September the Ordnance Department attempted to obtain the services of over 1,000 cost accountants. In October and November the Signal Corps alone employed 700 cost accountants, and in a few months' time the War Department had employed several thousand men as cost accountants. Not all of them bore this title, it is true; some were production experts, some accountants and others appeared under other classifications, but they were all employed for cost work. The different titles were used to open the non-competitive positions of the Civil Service to those who could not meet the far from exacting requirements of the Civil Service Commission.

It was just as essential to the manufacturer that he too be equipped with means for determining his manufacturing costs as it was to the Government that it have its cost men. Although some contractors performed work of such a simple nature as not to require the services of a cost man, we can safely estimate the number of cost accountants employed by industry during the latter part of 1917 and early months of 1918 at 7,500. This was the real birth of cost accounting.

In a short period of but a few months no less than twelve or fifteen thousand men were employed as cost accountants. Where did they come from? With only several hundred cost systems in operation, we know that as a rule they came without previous experience in the work which they were to take up. It is interesting to note just how these cost executives were obtained.

Places Filled With Ill-Equipped Youths

The accountants in charge of the cost-accounting sections of the various War Department offices first endeavored to obtain trained accountants for the supervisory positions, but hundreds of these men were required by the regular accounting branches and with the selective draft and only a small number to draw upon this source was soon exhausted. Men with bookkeeping experience and executive clerks were next called upon and so on, until we find the positions of assistant cost accountant and cost clerk filled by young men still clutching their business college diplomas in their right hand. The same conditions existed in the cost organizations built up by manufacturers. Are we to wonder that we are today finding the systems installed by these well-intentioned young men defective?

Under certain conditions it might have been possible to build up this force of men from the ranks of those particularly fitted to take up the work of the cost executive. On the other hand, those fitted for this class of work were in urgent demand for other phases of war work.

That this group of men failed in the task assigned them will be evidenced by an inspection of the records of the U. S. Court of Claims. Their task was to obtain cost data sufficiently comprehensive and authoritative to form a basis for the adjudication of the claims of those manufacturing under cost-plus contracts. A comparatively simple task when we think of the task we have assigned the present-day cost exec-

utives. Nevertheless, due to faulty cost data, wrangles over cost elements and other causes, the Court of Claims has many cases still awaiting settlement. All of this as well as present conditions are due to the fact that those selected for the work did not possess the essential qualifications of the cost executive.

Essential Qualifications of Cost E ecutive

The clerk with an aptitude for figures and detail or the accountant whose experience has been confined within the limits of accountancy is not qualified to assume the duties of a cost executive except in so far as his personal characteristics may qualify him for that work. Indeed, at present few men will be found who possess all of the essential qualifications of the cost executive.

This indispensable member of the progressive industrial organization must be of the executive type. He must be at once aggressive and tactful, courageous and loyal. He must possess resourcefulness and originality, imagination and initiative. It is scarcely necessary to add that he must be reliable and honest.

So much for the general qualifications. Many executives in all industrial activities possess these desirable characteristics, but the cost executive must possess many essential qualifications obtained only through training and experience. The present low level of efficiency of most cost departments is due largely to the failure of manufacturers to consider these special qualifications in selecting their cost executives.

Knowledge of Shop and Engineering Practice Essential

A good knowledge of shop practice is necessary. Without this knowledge, even the most simple problems of cost finding cannot be treated intelligently. A superficial knowledge will not suffice. Unless he is familiar with shop practice, the entire system will be operated upon a conjectural basis.

A knowledge of engineering practice is indispensable. It is at least difficult to imagine one without this knowledge successfully determining power costs and making intelligent distributions of these costs, particularly where high-pressure steam and exhaust steam are used in large quantities in the manufacturing processes. Depreciation, obsolescence and depletion rates can be intelligently fixed only by one having at least some knowledge of engineering fundamentals. Burden distribution is essentially an engineering problem requiring engineering treatment, and last, he must establish standards with the precision of an engineer.

Cost E ecutive Should Be Analytical and Have Knowledge of Statistical Laws

The cost executive must above all be analytical. He must be able to interpret cost data into terms sufficiently clear to arouse the management to immediate action. He must know what is pertinent and be able to isolate such facts from the mass of cost information flowing through his department. His studies and resultant cost reports must be exhaustive. Above all he must analyze his figures with a detached viewpoint.

The compilation of cost data requires statistical treatment. Certainly it is a phase of statistics. Without a knowledge of statistical laws on the part of the compiler, cost statements are of little value and apt to be misleading. Frequency, dispersion, correlation and other phases of statistics enter into the cost executive's daily work. By statistics we do not mean graphical presentation. So much has the word statistics been abused that the average industrial executive has come to look upon one who prepares attractive graphical charts as a finished statistician. Although these charts are valuable if intelligently prepared and not overdone they are not essential to successful cost finding and something more than the ability to draw charts is required of the cost executive along statistical lines.

The science of accounting provides for the exact recordation of known business transactions or facts. With the engineer's training and the knowledge of the statistician the cost executive is called upon to determine facts by means of approximation and averages. The accountant shuns this practice and denies that accuracy is unattainable. The successful cost executive realizes that he cannot attain accuracy, hence he establishes standards of accuracy and attempts to approach these standards in his daily work.

Knowledge of Accounting of Minor Importance

Last and of least importance, the cost executive should have a knowledge of the theory of accounts and practical accounting. One possessing the qualifications outlined in the foregoing will have no difficulty in rapidly mastering sufficient accounting knowledge to enable him to supervise the allocation and posting of results obtained by his system.

All of the above pertains largely to the operation of existing systems. As for the design and installation of a practical cost system, it is essentially the work of an engineer. To design a comprehensive system for the average factory manufacturing a multiplicity of products calls for engineering training and constructive ability. Even staid firms of public accountants now recognize this fact and their cost men are as a rule called cost engineers or some similar term from which the word accountant has disappeared.

Failure of Schools of Cost Accountancy

Where may men possessing the above qualifications be obtained in sufficient numbers to place industrial cost determination on a sound basis? Certainly not from schools. The writer recently examined the curricula of a number of well-known schools teaching cost accountancy. The following is representative and is the course of study adopted in one of the best known accounting schools in the United States:

Requirement for matriculation—high school diploma.
Sixty class periods in twenty weeks.
Studies:
- Theory of accounts.
- Practical accounting.
- Auditing.
- Law.
- Economics and finance.

Can we imagine the ambitious young man applying these teachings in determining production centers, ascertaining power costs, or coping with complex burden problems? No! As a matter of fact accountants have failed to apply even good practical accountancy to their work in cost departments. Had burden reserves been established in 1917 by those to whom fell the task of developing practical cost methods for industry, our whole economic structure might have been favorably changed and surely the effects of the present period of depression would not have been so disastrous to many of the 250 industrial concerns which have failed during the past six months.

Cost practice must conform to the principles of accountancy in so far as the actual recordation of ultimate cost elements are concerned. Beyond this cost finding is not a function of the accounting department. The successful cost man is a natural executive, an engineer by training with a knowledge of statistics and familiar with the fundamentals of accountancy. We shall not be able to obtain men with these qualifications readily—in fact, they will have to be developed. For the present, the task of setting cost finding on a sound practical basis is directly up to the manufacturer and the technicians forming his present organization. The task is not difficult or expensive.

Remedial Measures

In the majority of industrial organizations will be found individuals competent to solve different phases of our cost problem. By organizing these men into a group and properly co-ordinating their efforts we shall obtain a functional group competent to consider the problem before them and arrive at a practical solution. Its task will be the development of the new system or the simplification and improvement of an existing system. This group should be known as the cost committee or board.

The specific duties of the cost committee would be to determine the general method to be followed in cost finding. It should then fix production centers (if required) and develop media for the collection of costs. It would be its problem to arrive at the various methods to be followed in the determination of and distribution of burden. It would decide upon and develop a practical system of tabular and graphical reports for transmitting cost intelligence to the management. After the fundamentals had been established the actual task of compiling cost data would be delegated to a cost department headed by a capable executive working under the committee's instructions. The committee should not find it necessary to devote more than a few hours each week to its task.

In this manner a practical cost system can be developed and cost standards established. However, this in itself is not enough. We must have some method of checking standards—in short, manufacturers must establish common standards. Again, not all organizations have all of the men necessary to make up a complete cost committee. The incomplete committee seeking advice on certain phases of its work, as well as the committee seeking common cost standards, must go outside of its own organization for assistance and advice.

Many Organizations Could Aid

In this connection there are many organizations that can render service of inestimable value to the manufacturer by assisting in the determination of common cost standards and standard cost practice and helping the manufacturer in his effort to obtain a practical cost system. These organizations may be divided into six groups:

1. Community industrial organizations.
2. State and national manufacturers and trade associations.
3. Technical societies.
4. Industrial cost associations.
5. Manufacturers of machine tools and equipment.
6. Federal bodies.

Due to economic conditions nearly every manufacturing community houses several plants manufacturing similar products. This should prove of great value to the manufacturer in aiding him to arrive at proper cost methods. Through the exchange of ideas and discussion of their cost problems at community manufacturers' associations, the cost committee would be greatly aided in its work. Conditions as to labor and material costs vary among communities, hence community common cost standards would prove of greater value to the local manufacturer than national standards. However, both standards are necessary for comparative purposes, the national common cost standards serving as a check on local standards. The Rochester Industrial Management Council and such groups as the Sherman (Tex.) organization of industrial managers are excellent examples of what may be accomplished through the organization of industrial executives in the community.

National Trade Associations

National trade organizations are rendering a wonderful service in the development of uniform cost methods. Already many systems have been developed along practical lines and adopted. This means standardized cost practice and common cost standards and to many manufacturers has proved to be the solution to their cost problem. However, it is of tremendous importance that the national executives of these organizations exercise good judgment in the selection of uniform methods. Several of these uniform systems are open to the same criticisms as has been applied to our present general cost methods. Associations having uniform cost methods adopted several years ago upon the advice of consultants might well examine these methods for defects and take the necessary corrective measures where defects are found.

Technical Societies

There are ten different terms for "burden," eight different expressions used in lieu of "direct labor" or "direct material." The very word "cost" has not been clearly defined. There is no general agreement as to where factory costs start and stop. At least twenty-five different methods are offered for use in determining depreciation rates and four recent authors are at variance as to the method of determining material costs. Standards must be established. The various standardization committees of the technical societies can accomplish a great deal along this line. The American Society of Mechanical Engineers could render a great service by determining and publishing depreciation rates on standard equipment, while the American Society of Civil Engineers might render a similar service with reference to the depreciation rates on structures.

Industrial Cost Associations

Recognizing the urgent need for a better knowledge and control of costs, the Industrial Cost Association, with headquarters at Pittsburgh, was organized a little over a year ago. The membership is limited to manufacturers and managers of industrial corporations, firms, trade associations and employees in executive supervision of their cost methods. The aims of the association are to stimulate interest of manufacturers in correctly determining costs, standardize terminology, establish basis principles, simplify cost accounting and educate members in the use of modern methods of cost

analysis and control. The growth in membership of this national body has been rapid and is an excellent indication of the intense interest manufacturers are taking in the correct determination of costs. Much progress has already been made by this association, and there is no question that it will be a powerful factor in placing cost determination on a sound and practical basis.

Little, if any, progress has been made in five years in the formulation of sound principles for the determination of depreciation rates. Ardent advocates of any one of twenty or thirty different methods of determining the depreciation rates applicable to items of plant and equipment will be found in any industrial community. Even the accountants in the Internal Revenue Department have failed to clarify the situation as regards income tax deductions. However, as stated before, this is not an accounting problem.

Makers of Machine Tools and Equipment

By working in conjunction with technical societies the manufacturers of machine tools and equipment can dispel a great deal of the confusion existing at this time. Their files contain ample data from which authoritative information covering the life of their product under various conditions might be compiled. Such information published in a form similar to that adopted by the National Electric Light Association in connection with power requirements of equipment would greatly simplify one of the cost executive's most vexatious problems.

Federal Bodies

Much valuable information which would be of great assistance in standardizing cost methods is stored away in the governmental archives at Washington. The act of Sept. 26, 1914, and later the Clayton act authorize the Federal Trade Commission to make public from time to time such information as it shall deem expedient in the public interest. The aid of this commission has been proffered to industry a number of times by its former chairmen. The intelligent preparation and publication of bulletins on cost methods would greatly increase the value of this commission to the public.

It has first-hand experience and knowledge with many existing systems. This commission could furnish a great deal of authoritative information on the establishment of the necessary reserves required by sound cost practice. Other departments, such as the Bureau of Standards, could render real service along various lines, all with the purpose of placing industry on a sound basis of cost control. With the intelligent co-operation of the above-mentioned bodies and a distribution of technical cost functions among those members of industrial organizations qualified to perform these functions an accurate practical cost system is easily attained.

Untold Millions Lost Through Lack of Proper Cost Method

During the past five years lack of proper cost methods has cost American industry millions upon millions of dollars. Unless manufacturers take the necessary steps to fortify themselves with a sound basis for the fixation of selling prices and, of more importance, provide means by which they can intelligently control their manufacturing operations it is but a matter of a few years before such manufacturers will be eliminated by their more farsighted competitors.

Industrial executives who have blind faith in their existing cost system will do well to examine into methods used and take the necessary corrective measures to place their house in order. In many of the most progressive manufacturing institutions in the country it will be found that the much-vaunted savings effected by industrial engineers or men holding kindred positions will be nearly offset by making a proper redistribution of burden rates over the period of abnormal production. Through the application of inadequate burden rates on overloaded plant facilities the manufacturer has been left "holding the bag" during the present period of depression. It is his move! To avoid a checkmate or at least to escape a stalemate at the hands of his progressive competitor he must move intelligently and quickly.

Once methods have been established and proved sound they should be adhered to despite the wailing of impractical theoreticians. It should always be borne in mind that actual costs cannot be definitely established, but practical costs are within the reach of all.

Freeport, Ill.

Opportunity for Governmental Assistance in Waste Elimination

The opportunity for governmental assistance in waste elimination has been outlined by the Committee on Elimination of Waste in Industry in the summary of its report (July, 1921). It recommends the establishment of a national industrial information service, a national statistical service, a body of principles for the adjustment of labor disputes and a nation-wide program of industrial standardization.

A national industrial information service should furnish timely, regular and complete information on current production, consumption and available stocks of commodities, supplementing the work of private agencies.

A national statistical service should be established and maintained covering employment requirements and conditions throughout the country. The fundamental knowledge required to make a correct analysis of unemployment in any period is not at present obtainable. The meager information for such a study has to be collected from many agencies. These are under no central control, they are often not in contact and frequently duplicate effort.

A body of principles for the adjustment of labor disputes should be accepted which can be developed with experience. Thus far American legislation for the settlement of these problems presents almost as many varieties as there are states.

A nation-wide program of industrial standardization should be encouraged by the government in co-operation with industry. In the standardization of design of product, methods of procedure and number of models, there rests a large opportunity for the reduction of waste. It is not sufficient, however, to attempt to standardize the product of a given industry, for almost every industry is so dependent upon others that they too must co-operate. The Federal Government could call together the representatives of the trade associations of interdependent industries and in co-operation form committees for this purpose. The opinions or decisions of such committees might from time to time be promulgated as standards of practice.

The Elimination of Construction Wastes

A Comprehensive, Dollars and Cents Analysis of the Preventable Wastes in the Construction Industries and a Thorough Understanding of the Responsibility Imposed Upon the Contractor, Owner, Architect, Engineer and Workman

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WASTE exists in the construction industry as in other industries, and, it may be, to a greater extent due to the peculiar conditions surrounding construction operations. The relatively short duration of each job entails an almost continuous process of organizing and reorganizing, building up a working force on a small nucleus, and in numerous cases moving a force from one section to another.

For the purposes of this article, only those phases of the construction industry have been considered which pertain to the assembly of materials of construction into the completed work. No attempt is made to cover the manufacturing or merchandizing of building materials.

The number of men engaged in the United States in the construction industry thus defined is estimated for the year 1919 by the Prudential Insurance Co. at 1,575,000, as compared with a total working population of 42,503,000. The number of workmen employed in the construction industry is exceeded only by the numbers employed in agricultural pursuits, general manufacturing and steam railways.

The annual expenditure involved in the construction industry in the United States for the years 1919 and 1920 is estimated to be $3,640,000,000. The statistics available for the first six months of 1921 indicate that expenditures for this year will not be much less. These figures will be used for purposes of argument with the realization that prices both of materials and labor are above normal.

The sources of waste considered in this article are those due to the customary manner of letting contracts, to the abnormal risk in the construction business, artificial restriction of output, intermittence of employment, labor turnover, use of construction plant and tools and a few other miscellaneous causes.

Waste Due to the Manner of Letting Contracts

Considered in the chronological order in which waste appears on any construction undertaking, the manner of awarding the contract comes first.

The general procedure on building work is this: The owner, either directly or through his architect or engineer, prepares plans and specifications for the project in mind and invites contractors to submit bids for the complete work. The contractor must take the plans, determine in detail the quantities of each item involved in the project, fix the unit prices for which he believes the work can be performed, prepare the estimate for the entire project and submit his proposal.

From observation and experience, it is estimated that an average of eight general contractors submit proposals on each project and an average of two and one-half sub-contractors in turn furnish proposals to each general contractor for each of the items of the project to be sublet—a total of twenty to the eight general contractors. If bidding on building work, each of the eight general contractors must prepare a quantity survey for the entire project and each of the sub-contractors must prepare a quantity survey to cover the item on which he proposes to bid. Here is one of the greatest wastes in the construction industry and one of the wastes which can be easily eliminated by having the quantity survey prepared by the architect or engineer, as is the common practice on engineering projects.

The cost of preparing the quantity survey to each general contractor and his corresponding sub-contractors is estimated to range from $500 to $1,500 for each $1,000,000 involved, or, for eight general contractors, a total of $4,000 to $12,000 for each $1,000,000 involved in a contemplated project. This cost does not include any allowance to the contractor for determining the price for which he will perform the work, since that cost must be incurred by each contractor even if he is supplied with a quantity survey. If the quantity survey be prepared by the owner's architect or engineer, the cost of one operation only will be incurred and the saving for each $1,000,000 of contemplated work will be $3,500 to $10,500.

The total contemplated work for the United States—that is, work on which bids were requested—for the years 1919 and 1920, based on the F. W. Dodge Co. statistics for the twenty-seven northeastern states, is estimated at $6,200,000,000 and $7,000,000,000 respectively. An approximate figure of $6,000,000,000 will be used. Of this total more than three-quarters represents building work on which lump sum bids are requested, as compared with less than one-quarter, which represents engineering projects to be let on unit price or cost plus a fee basis. Assuming that $4,500,000,000 worth of work is tendered for, that an average of eight general contractors bid and that the cost of preparing each quantity survey is $500 per $1,000,000 of the estimate, then the total cost of making the quantity surveys for this volume of work would amount to $18,000,000, of which all but $2,250,000, or say $16,000,000, would represent waste due to multiplication of effort.

Waste Due to the Abnormal Risk in the Construction Industry

It has been estimated on the basis of income tax returns that the risk involved in the construction industry is extreme when compared with manufacturing, commercial pursuits, mining and quarrying. These sources of information show that in manufacturing industry the loss is 3c. for every dollar of gain; in trading, mining and quarrying, 7c. for every dollar of

gain; while in the construction industry, the loss is 25c. for every dollar of gain.

The total volume of work performed in the United States during 1920 has been previously estimated at $3,640,000,000. Of this total, probably 4 per cent would represent net profit, say $145,000,000. At the ratio of 25c. to one dollar, the corresponding loss would be approximately $36,000,000. That the construction industry can be placed on a plane of no business loss or even that it can be placed on a plane of as small a loss as manufacturing, mining, quarrying, trading, etc., is not to be expected, but it seems reasonable that it can and should reach a plane where the loss would not be greater than 10c. instead of 25c. on every dollar of profit in new construction. On such a basis, the loss would be $14,500,000 instead of $36,000,000, or a saving of $21,500,000.

The causes of abnormal losses in the construction industry include the natural tendency to let work to the lowest bidder unless there is some positive reason for not considering his bid, ambiguous plans and specifications which leave room for doubt as to their interpretation and lack of a quantity survey supplied by the owner, and the practice of requiring lump sum bids where quantities are not definitely ascertainable and working conditions cannot be foreseen.

The remedies for these losses consist of a thorough investigation of the contractor before letting the contract, the furnishing of a quantity survey by the owner which will insure all contractors bidding on the same quantities, the standardizing of specifications so that they will mean the same thing to different contractors, letting work on unit price or on cost plus a fee basis when quantities are not ascertainable and conditions unknown.

Waste Due to Accidents to Workmen

Forty-two of the forty-eight states in the Union have passed employers' liability or workmen's compensation acts which hold the employer liable for accidents incurred by workmen in his employ. The compensation acts provide for the payments to be made to the workman, the safeguards with which the employer is to surround his operations and, through the state insurance commissioner, the rates which are to be charged by the insurance and indemnity companies for carrying the employers' liability or workmen's compensation insurance.

The amount of such insurance which the contractor must carry ranges from about 3 to 10 per cent of the payroll. The rates vary quite decidedly for different states. For instance, the rates for New Jersey, a low-rate state, compared with those for New York, a high-rate state, for some of the commoner building trades are:

	Rates per $100 of Payroll	
	New Jersey	New York
Masonry	$3.36	$8.30
Concrete work on buildings	2.94	7.49
Carpentry work outside	3.51	11.564
Carpentry work inside	0.70	2.102
Structural steel workers	9.07	27.569
Grading	0.98	2 397
Cellar excavation less than 12 ft. deep, no subaqueous work or blasting	1.15	2.76
Blasting	13.83	22.80
Millwright work	1.72	3.833
Miscellaneous labor	1.72	3.833
Supervision, including superintendents and engineers	1.19	1.560

An average rate may be conservatively estimated at 4 per cent of the payroll cost. It has been pointed out that the total volume of construction business carried on in the United States during 1920 was roughly $3,640,000,000. Assuming a ratio of labor to total cost of work of 1 to 4, the payrolls for this work would aggregate approximately $910,000,000. At a rate of 4 per cent the total cost of compensation insurance would be, say, $36,000,000.

Waste Due to Restriction of Output by Labor Organizations

An extremely serious cause of waste in the construction industry is due to restriction of output by labor organizations. This is an economic waste which directly affects the owner but indirectly affects the workman himself, since the resulting waste of capital prevents its use for other production, which in turn would offer increased opportunities for employment.

Those who are interested in a more detailed treatment of this particular phase of economic waste in the construction industry are referred to a splendid paper presented by Charles R. Gow of Boston before the Boston Society of Civil Engineers on March 24, 1921. Mr. Gow estimates that the restrictions imposed in Boston by labor organizations increase the cost of building at least 25 per cent. The average for the entire United States, however, would probably be closer to 10 per cent. On this basis, on the approximate volume of construction work completed during 1920, $3,640,000,000, the waste would amount to $36,000,000.

Waste Due to Intermittence of Employment

Another most serious economic waste in the construction industry is intermittence of employment. This is classed by the Committee on Elimination of Waste in Industry of the American Engineering Council as the greatest waste in the construction industry, and considering that the loss is suffered by owners, contractors and workmen, this is very probably true. The comparatively short period of employment of workmen in the building trades throughout the year is not generally recognized.

If by some means the building period could be distributed more nearly over the entire year, instead of being bunched in about eight months, it is probable that labor would accept a slight reduction in hourly rate so long as the yearly earnings would not be reduced. The result would be that the owner would be paying for net time worked instead of for such a high percentage of idle time as well. Take the carpenter as the typical case. He works 73 per cent of the year. If his work could be distributed so as to enable him to work 90 per cent of the year for the same total earnings, the saving to industry would be 17 per cent of his annual earnings. This ratio applied to the total estimated labor payroll of approximately $900,000,000 for 1920 would be $15,300,000.

Waste Due to Labor Turnover

A loss closely allied to the waste due to intermittence of employment is the loss through changing personnel of employees, commonly called labor turnover. The losses due to this labor turnover are greatest during periods of scarcity of labor, since the tendency during those periods is for workmen to feel more independent, to be less efficient and quicker to move from

one employer to another. Consequently it is difficult to determine with any degree of accuracy what the losses due to this turnover are. Some approximation, however, may be made to indicate the possibilities. Assuming 1,575,000 men engaged in the construction industry and an average number of engagements for each man per year of four, the total number of men engaged would be 6,300,000. If the average number of engagements per year could be reduced to three, the saving would be 1,575,000 engagements a year, and if each engagement cost only $5, including the cost of employment bureau and the cost of training the new man to his work, the total loss to the contractor alone, neglecting entirely the loss to the workman, would be about $8,000,000.

Waste Due to Lack of Proper Cost Accounting

Another waste in the construction industry which may correctly be attributed to incompetent administration is extravagance in the use of both materials and labor. The most effective means of controlling such waste has proved to be the maintenance of accurate and promptly available records of materials used, and unit costs of labor involved in installation. There is nothing new about such cost accounting, but it is not a rash assumption that numerous contractors apparently carrying on work with a high degree of success are not taking advantage of a proper accounting system which would enable them to effect considerable savings for themselves and the owners.

On large undertakings this saving might amount to 10 per cent or more of the total payroll. On the job of average size of $30,000 the saving would be less in proportion. For all work the saving would probably average 4 to 5 per cent per year or, say, roughly $4,000,000.

Waste Due to Improper Construction Equipment

The average cost to a construction undertaking for the use of construction equipment is approximately 1¼ per cent of the total cost of the work. The labor cost of erecting and handling but not operating this construction equipment is 0.4 per cent; making the total cost to the job for the use of plant 1.65 per cent of the total cost of the undertaking. On the basis of an annual volume of work amounting to $3,640,000,000, the annual cost for construction plant would be about $60,000,000.

The average cost of small tools is about 0.75 per cent of the total cost of the undetaking and on a similar basis would amount to $27,300,000. The total annual cost of both construction plant and tools would be roughly $90,000,000.

It is obvious that good judgment must be used in selecting and laying out the construction equipment required for the execution of any undertaking. It is not unusual to observe work on which the intelligent use of equipment would reduce labor costs appreciably after making allowance for the rental on the equipment. Possibly it is a more unusual occurrence, but it is far too common to observe work where the savings effected by the use of plant do not justify the amount of plant involved. More frequently still it happens that a proper amount of plant is in use but is not so arranged as to produce the best results. Observation indicates that the annual loss due to improper or improperly arranged equipment exceeds 10 per cent of the rental of equipment, or more than $6,000,000.

All contractors are familiar with losses which occur in the use of small tools, and various means have been employed to reduce such losses, such as the refusal to supply tools to those trades which customarily supply their own tools; the charging against each individual of the value of the tool which he borrows from the store room, holding him responsible for its return; and maintaining a salvage corps whose duty is not only to look after all scattered material but also to check up tools which may be found lying around. The experience of one construction company indicated an annual loss of as high as 20 per cent of the value of the small tools which was eliminated by the vigilance of the salvage corps. Ten per cent would appear to be a conservative estimate of the preventable waste in small tools, or say $3,000,000.

Miscellaneous Waste

Various miscellaneous forms of waste occur in the construction industry which are difficult of translation into concrete figures. Among these is bad management, which in a degree is responsible for all of the losses which have been previously dealt with, and, in addition, for other losses more out of the ordinary, such as excessive costs for material and labor, waste of material, errors in executing work, as well as errors of judgment which may result in the performance of the work at a loss both to contractor and owner.

Multiplication of effort on the part of the owner, architect, engineer and contractor. This consists in maintaining various sets of inspectors, material checkers, time keepers, etc., who are certainly not necessary on all work. Closer co-operation among owner, engineer and contractor should do away with a certain amount of this multiplication of effort. The contractor frequently needs no more supervision than the architect or engineer, and the contractor who requires more inspectors than are necessary to assist in the interpretation of the owner's, architect's or engineer's ideas should not be employed on the work.

Conclusion

To sum up, there is waste in various forms in the construction industry, some of which can be materially reduced by proper effort on the part of the contractor, the workmen, the owner and his architect or engineer. It is believed that the following figures represent roughly the annual amount of preventable waste with a volume of business equal to that of 1920:

Manner of letting contracts	$16,000,000
Abnormal risk in the construction industry	21,000,000
Accidents to workmen	30,000,000
Restriction of output	36,000,000
Intermittence of employment	15,000,000
Labor turnover	8,000,000
Lack of proper cost accounting	4,000,000
Improper use of construction equipment and tools,	9,000,000
Total	$139,000,000

This amount is equivalent to 3.8 per cent of the total annual expenditure in construction work and is practically equal to the total annual net profits of the entire construction industry.

Rough as these figures are, it is believed that they err in being low rather than high.

With such a showing, the responsibility clearly devolves upon all engaged in the industry to exert themselves to eliminate the preventable waste. It can be done.

New York City.

Some Considerations on Fire Waste

Industry in General, and the Chemical Industry in Particular, Is in Need of a Fuller Appreciation of Fire Hazards and the Appalling Waste Due to Destruction by Fire—Review of Possible Fire Hazards

BY NICHOLAS RICHARDSON
Research Engineer, Watertown Arsenal

OUR fire waste is enormous. Daily and hourly much of our wealth goes up in smoke. Our dwellings, factories, crops and forests are being destroyed at a rate which must cause every thoughtful person often to doubt our general intelligence. The daily accounts in the press of disastrous fires, the continual spectacle of fire engines dashing through the streets of our cities, the smoke of our forest fires, have become a national institution which would appear to be accepted with complacency, and it is impossible to believe that the public in general can have any true appreciation of how great and how serious a waste it all entails. A very large proportion of this waste is preventable and therefore unnecessary.

INSURANCE A TAX TO HELP THE FEW

There are some, doubtless jealously regarding themselves as responsible citizens, to whom the spectacle of a fire or the dramatic newspaper account of a conflagration is no more than a welcome diversion, and it is no exaggeration to say that there are many such. How often, when it is learned that "the loss was fully covered by insurance," is a feeling engendered that there has been practically no loss at all, and how many of us forget that insurance is simply a taxing of the many to help the few! We are all obliged for self-protection to indemnify the careless and the negligent.

When material is destroyed by fire it is gone, irretrievably lost, and the world is so much the poorer. When any useful thing is wasted we must inevitably pay more for that thing than we otherwise should, and every fire increases the burden of living.

We are speaking now of the actual waste of goods by fire, but it must also be remembered that there is an enormous consequential expenditure of money, time, energy and thought for fire-fighting and for protection against hazards which ought not to exist. Is not all this also waste?

The foregoing remarks are commonplace and trite. The appalling facts are repeatedly being published, and homilies on the lines of the above are reiterated in current trade and technical journals. The business man, while smoking a cigarette in an interval of business, reads such remarks with weariness, and closes the paper with a feeling of boredom, the while nonchalantly throwing his cigarette through the office window. The cigarette falling ignites an awning below; a blaze occurs; an alarm is rung; the firemen arrive; traffic is held up; the awning is destroyed, windows are broken and hundreds of dollars' worth of goods damaged.

The owner of the awning at once communicates with his insurance agent, and in a day or two he sees, not without satisfaction, a new awning beautifying his premises. And so trivialities of daily life go on.

Fire hazard is always present, and must be so under the conditions in which we live. Our very existence depends on slow oxidation and a large proportion of the substances which are necessary to our lives, particularly material necessary for our food, clothing and shelter, the fundamentals of existence, have so great an affinity for the oxygen of the atmosphere that it requires but a slight increase in temperature to start rapid combustion and the necessaries of life are violently converted into different and useless compounds, and as far as we are concerned they are irretrievably wasted.

Such being the case, it would seem natural that every person would learn from the cradle that fire must be regarded as a vicious enemy and that continued heed and care must be given that uncontrolled fire shall not be allowed to start. But that it is not so is evident from the record of our fire waste. There is, however, some hope for the future. The increasing instruction of children in schools as to fire dangers, the training given to Boy Scouts and the institution of "clean up" and "fire prevention" periods will doubtless tell in a more careful and less wasteful generation. In the meantime, however, the waste goes on, as the following figures will show.

RECORDED FIRE LOSS NEARLY QUARTER MILLION YEARLY

The Actuarial Bureau of the National Board of Fire Underwriters lately published a table showing the recorded fire loss in the five-year period from 1915 to 1919. This table includes the losses on insured property only, and a large addition must be made to account for uninsured and unreported fires. It is important to note that forest fires are not included and it would be difficult to estimate in dollars the loss and waste due to the destruction of growing timber. The amount must be enormous, and the waste thus occasioned to one of our most important national resources is deplorable.

During the five-year period from 1915 to 1919 there was a recorded and insured waste of $1,133,100,676. To this amount is added 25 per cent, which is a conservative estimate of the value of uninsured and unreported losses. The total thus reaches the staggering figure of $1,416,375,000. The National Board of Fire Underwriters in publishing the figures points out that this amount if used instead of wasted would provide homes for a population exceeding that of the State of Connecticut. In the five-year period considered there has therefore been an annual fire waste to the amount of $226,620,135 in recorded and insured fires.

The present five-year period promises to exceed this startling record. The waste during 1920 was considerably more than $500,000,000, or double the average

annual waste of the five-year period considered. Nor is there much hope for a betterment this year. From January to June, 1921, the fire record stands at $164,926,300 and there appear no grounds for an expectation that the record for the coming half year will be low enough to bring the year's total to a figure at all favorable in comparison with the average of the past, enormous though that average is.

25 Per Cent Entirely Preventable

In examining the table it will be seen that the losses with their causes are arranged in the order of their magnitude. The first and most striking fact is that 25 per cent of the total is due to causes which are entirely preventable, the remainder being classed as "partly preventable." Space will not permit of detailed analysis of these preventable causes, nor is an analysis necessary. Any intelligent man can see at a glance how simple and obvious the causes are.

RECORDED FIRE LOSS DURING FIVE-YEAR PERIOD BETWEEN 1915 AND 1919

Preventable Causes	Amount of Loss	Per Cent of Total
Matches and smoking	$73,474,348	6.4
Defective chimneys and flues	56,650,915	5.0
Stoves, furnaces, boilers and their pipes	55,133,181	4.9
Sparks on roof	29,271,585	2.6
Petroleum and its products	25,910,434	2.3
Open lights	13,956,032	1.2
Hot ashes and coals, open fires	11,806,754	1.0
Gas, natural and artificial	10,203,330	0.9
Ignition of hot grease, oil, tar, wax and asphalt	4,490,269	0.4
Rubbish	3,511,824	0.4
Steam and hot water pipes	1,851,434	0.2
Fireworks	1,499,854	0.2
Total	$287,759,960	25.5
Partly Preventable Causes		
Unknown causes, probably largely preventable	$360,587,544	31.8
Exposure, including conflagrations	202,176,433	17.8
Electricity	84,086,471	7.4
Spontaneous combustion	49,702,886	4.4
Lightning	39,828,489	3.5
Sparks from machinery	31,862,424	2.8
Sparks from combustion	25,144,191	2.2
Incendiarism	21,596,965	1.9
Miscellaneous known causes	20,193,164	1.8
Explosions	10,162,149	0.9
Total	$845,340,716	74.5
Total fire waste in five years	$1,133,100,676	

Can any valid excuse be offered for waste caused by defective chimneys and flues, or fires caused by hot coals and ashes? It is sad to acknowledge that smoking is accountable for nearly 6½ per cent of the total; and the reformers who are now working to place tobacco under the ban along with liquor have in this an argument difficult to refute.

It may here be remarked that "exposure, including conflagrations," which accounts for nearly 18 per cent of the total waste, is one of the peculiarly vicious features of the causes of fire waste. It is here that the innocent suffer for the guilty and where one who employs all means to prevent fire may suffer disastrous losses owing to the neglect and carelessness of his neighbor.

"Common" Hazards

In the language of fire prevention, the potential causes of fire are classed as "common" and "special" hazards. Common hazards are those which are met with everywhere, and include the fire hazards of heating, lighting, power, disposal of rubbish and the like. It is very easy to learn how all common hazards may be safeguarded, and it can truthfully be said that any fire originating in a common hazard is evidence of neglect which may amount to criminality on the part of someone.

As shown in the table, common hazards are by far the greatest causes of fire waste, and it is in the common hazard class where there is the greatest field for improvement. The means for safeguarding all the common hazards have long been practically standardized, and ignorance can no longer be claimed as an excuse for fire waste arising from common hazard causes. The National Board of Fire Underwriters, the National Fire Protection Association and other organizations publish information covering all prevention methods for common hazards. Such information is available to all. Instruction given in schools and other institutions must place all this information at the disposal of everybody.

"Special" Hazards

In the field of special hazards there are problems of more interest to the technician and specialist, and there is still much opportunity for research. Special hazards are the potential causes of fire arising from the technique of manufacture, and practically every type of manufacturing has its peculiar and necessary special hazards. In this connection most of the credit for safeguarding innumerable manufacturing processes is due, not to the manufacturers themselves but to insurance interests, and not only the protection of special manufacturing processes but also the proper arrangement and conduct of industrial operations effectively to prevent or minimize possible fire waste frequently must be pointed out by insurance men.

To illustrate this line of thought, an example may be taken by considering the common course of events when a new factory—let us say, for example, a chocolate and candy factory—is started. The plant is designed by engineers in consultation with a candy-manufacturing specialist, and the plans are laid out for the most efficient and economical handling of material from raw stock to finished product. The type of construction may be of the best and the provisions for the safeguarding of common hazards may be above criticism. The plant is built and finished and production begins. The building machinery and stock represent a large capital outlay and the dread of loss by fire looms large, although the president of the concern himself "cannot see where a fire can possibly start." The plant, however, must be insured and a policy is written covering buildings, machinery and stock. Then comes the question of the rate to be paid, and the treasurer learns some things which may cause him many bad moments.

Insurance "Requirements" Appal the Manufacturer

The insurance engineers inspect the plant and in due course a list of "requirements" arrives, only on the execution of which will a rate be made which appears to approach reasonableness according to the ideas of the treasurer. In the first place, the plant is not protected with automatic sprinklers, an omission which causes the rate to be several times as great as it otherwise might be. It is then discovered that there are no "cutoffs" of value, and for the first time the obvious fact is noted that if large values in stock and machinery are concentrated together without division walls which could stop or at least check the advance of fire, the chances of a large destruction resulting from a possible small fire are many times increased. The erection of dividing fire walls or "cutoffs" is strongly objected to by the production manager and it

is difficult to convince him that a small fire could completely stop his entire production for a long period and in a few moments wipe out all the saving which he could show by the elimination of fire walls or divisions.

It is then pointed out that raw stock or possibly finished goods of large value are stored in basements resting directly on the ground and no provision made for drainage of water, and in this case it probably will be impossible for the insurance engineer to convince the works manager that the expense of "skidding" or raising all stock from the floor is worth while, nor will he possibly be convinced until a small and perhaps insignificant fire occurs in some upper floor, and the water used in extinguishing the fire, flowing to the basement, damages the whole stock therein. The writer remembers a case where the actual fire loss was $10; the water used in extinguishing the fire damaged goods to the extent of $14,000, and an expenditure of a few dollars only in raising the stock from the basement floor would have saved it all.

Common Practice to Take a Chance

The special hazards of chocolate and candy making, then, receive the attention of the insurance engineer. It is found that the dry and hot rooms are made of wood, that cocoa grinding is carried on in an important part of the building without protection against explosions, that there are unprotected ducts between floors and many other special hazards not protected in any way. The managers blame the architect, the architect blames the production manager, they all damn the insurance companies, and the insurance engineer marvels at the ignorance and pigheadedness of some great executives! The matter ends in a "business" man's decision. It is calculated that it will be to immediate financial benefit to refrain from carrying out the requirements and to pay the larger rate. So things are left to chance. All may go well and no fire may occur; on the other hand, a fire may occur and the resultant loss and waste will inevitably be many times greater than would have been the case had the advice of the insurance interests been heeded. This simple scenario may appear to be highly colored, but every incident is founded on fact, as any insurance engineer can testify.

It is time that elimination of waste by fire be recognized as a duty by the large business interests and a more altruistic attitude assumed by those who deal with the material of the common wants of men. That a few may increase their riches by risking the resources of the world is a terrible wrong, but it is unfortunately a widespread custom.

Close Investigation of Fire Risks Needed in Chemical and Allied Industries

New production methods are continually being adopted in practically all types of manufacturing. Many of these methods may entail some fire risk and therefore a close investigation of all changes in manufacturing processes should be made before they are put into practice. In the so-called chemical and allied industries this is especially necessary. Of late years the great increase in the synthetic production of many substances has introduced many hazards into manufacturing which can be appreciated only by technical men of high training. Our chemists have as high skill as any in the world and at the present time our colleges and technical schools are turning out young men equipped with scientific knowledge who willingly accept minor positions in chemical factories. There is an abundance of knowledge and ability to foresee and guard against possible dangers, but with it all too often the fire hazard situation is overlooked or wilfully neglected. The chemist who has conceived a process is too anxious to have his ideas pushed to fruition, and the production man is too eager to obtain a large and low cost output to permit any delay or additional expense which might be necessary to make the process actually safe. It is an unfortunate fact that highly gifted technical men are not always good business men, and on the other hand a good business man seldom has sufficient technical knowledge to appreciate the practical dangers which may accompany some brilliantly conceived technical process.

Potential Risks of Fire in Chemical Plants

An outside person critically inspecting a large number of chemical and allied plants cannot but be impressed by the numbers of potential risks of fire waste which may appear to him self-evident. How often is dye grinding carried on in the same building and right in the midst of a stock of finished dyes, whose value may reach hundreds of thousands of dollars. Such stock can be rendered valueless, or in other words can be turned into waste by a comparatively slight accident. Again, how often is nitrating—a process always accompanied by the greatest danger—practiced in close proximity to valuable machinery and large amounts of flammable material. The writer has suffered contempt little short of insult from chemists and managers who are eminent in their line because he has pointed out possibilities of fire and explosion waste and suggested preventives which were obvious in their simplicity. And not a few times has the possibility suddenly changed to an actuality; and waste to a greater or lesser extent has followed.

Little Study of Fire and Explosion Dangers

The study of fire and explosion dangers in dye and other synthetic chemical factories has been made by very few. Indeed, no one who is not an experienced chemist is capable of tackling the subject with intelligence. There are of course a number of dangerous processes which today are so common in chemical manufacturing that the dangers incident to them are or by this time should be well known to all, but the attempts at "short cuts" and the continual introduction of the manufacture of new compounds may be accompanied by unexpected dangers.

The history of a case could be recited where an old and (in its own estimation) careful concern registered indignant surprise when it was suggested that its plant for making H acid represented considerable danger. The accident which followed not long after "surprised" a workman into the next world and the insurance companies to the tune of thousands of dollars.

The types of organic compounds which are synthetically manufactured are never very far removed from true explosives. Sometimes it takes but little to change innocuous material into a sensitive explosive.

It must of course be recognized that occasionally a manufacturer is unable to carry on his business were

he to protect himself against possible accident in a manner which is actually effective. Circumstances may be such that he is obliged to trust to chance that an accident will not occur. He probably considers that he is in fact properly protected by the insurance he carries, and from his own financial viewpoint it is possible that he is so protected. But when the accident occurs there is an addition to the world's waste for which somebody will certainly suffer. It may be argued that advance is made only by those who will take chances, but nothing can be considered as true progress if preventable waste is the accompaniment.

Investigations That Should Be Made

Attention has been drawn above to the fact that research and progress in fire prevention and the proper safeguarding of dangerous manufacturing processes have been initiated and to the largest extent carried on by insurance interests. This is proper and natural enough, but it is unfortunate in creating an impression among many that it is only a trick of fire underwriters to increase their profits. It would be well in many instances if the insurance features could be disregarded and fire prevention problems considered solely from their necessity in order to reduce waste. There are simple broad lines on which all new industrial propositions should be carefully investigated before they are put into any considerable operation. Such an investigation should examine into the following matters:

The nature of the raw stock to be used; its degree of combustibility and susceptibility to damage by heat, smoke and water; the safe storage of raw stock; the avoidance of concentration in one area in order that the smallest practical amount may be subject to damage by any one fire. The same of course applies even more to the storage of finished goods, these representing not only the material itself alone but also the labor and thought expended upon it. True fireproof construction of all manufacturing and storage buildings is naturally the most desirable in the majority of cases.

Fireproof Building May Be Ideal Furnace

In this connection it must be remembered that fireproof construction does not mean that a building is composed only of non-combustible material, for although such a building will not burn it can very easily be destroyed by fire. It is understood that Mr. Edison discovered this fact by practical experience. It is remarkable, but nevertheless a fact, that many experienced business men cling to the delusion that if machinery and stock are housed in fireproof buildings no further anxiety need be felt as to fire. The absurdity of this is evident, since many a strictly fireproof building is so designed that it becomes an ideal furnace for the burning of combustible material.

In continuing the review of the possible fire conditions inherent in any proposed manufacturing enterprise, a close study of the separate and individual processes should be made. Any process producing dust and processes using volatile flammables will certainly be exposed to danger of explosion. Where such dangers are very great, such processes should be isolated. It is usually easy to arrange any dangerous process in such a way that the occurrence of an accident will entail only small waste, but it is essential that a recognition of the danger and adoption of precautions take place before an accident can occur.

An example of the great possibilities in the prevention of fire waste and loss by the scientific study of special hazards may be cited in the history of cotton mills. In the past cotton mills were particular sufferers from fire losses and were considered as a type of manufacturing to which fire was an inevitable concomitant. With the organization and development of the Factory Mutual Insurance Association honest efforts were made to improve conditions. The type of construction, the handling of stock, the peculiar fire risks incident to cotton picking, carding and spinning were made the careful study of trained engineers, and methods and means of annulling dangers were rapidly devised. Automatic sprinklers, together with efficient fire-fighting appliances, were brought into general use—in a word, the whole question of preventing fire waste was taken up carefully and systematically. The result is that cotton mills today have an excellent record as to fire waste, and fire losses of any magnitude due to the heavy special hazards of cotton manufacturing are almost unknown.

It would not be fair, however, to compare an old and standardized industry such as cotton manufacturing with so new and inexperienced an industry as synthetic dye making. The point, however, lies in the fact that if attention is given to fire prevention the fire waste due to special hazards in any industry will be enormously decreased.

New Industries Create New Hazards

Our industrial growth has been great, and every year sees types of industries begun that are new to the country. Since this is a country of new things, it behooves us to have our eyes open to new dangers. It is superfluous to specify examples of new enterprises where grave dangers may be introduced unless the need of scientific fire prevention is recognized from the very beginning of operations. The phenomenal increase in the use of gasoline and fuel oil, necessitating the installation of storages for great stocks of these flammables right at the very doors of our industrial centers, is only one example. At this writing news comes of a fire where millions of gallons of oil have just been wasted and where had proper consideration been given to fire prevention in the isolation of units and the proper construction and dyking of tanks, the waste of one of our most valuable and limited national products would have been immensely reduced, if not entirely prevented.

Nothing has been said of our waste of life by fire, but when it is emphasized that 20,000 persons meet death annually by fire, and meet death in the most terrible way imaginable, enough has been said on that point. It is horrible even to think of what death by fire means, and it is impossible even to estimate the economic loss in the waste of human life.

Enough has been said to justify an earnest plea for the more general recognition of the needlessness of our colossal fire waste. For the reproach of our fire waste owing to common hazard causes we are all to blame, and every one of us can help to reduce the national blot. As to the waste due to special industrial fire hazards its reduction lies with the heads of factories.

The protection of much of our national resources lies in their hands and setting aside selfish and present financial gains they should consider it a duty to the nation to see to it that preventable fire waste shall cease so far as they are concerned.

Watertown, Mass.

Location as a Factor in Eliminating Industrial Waste

The Main Factors to Be Considered in the Selection of Proper Location for Industrial Plants Are: The Influence Which a Proposed Industry Will Have on the Community, Raw Materials, Transportation, Labor Supply and Power

By VICTOR V. KELSEY
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THE importance of the proper location of industries as a factor for the elimination of industrial waste is a point conceded by all, but is frequently overlooked until too late to make a change.

In selecting a location for an industry a number of important questions naturally arise which should be thoroughly answered before reaching a final decision for the plant site. To arrive satisfactorily at the correct answers it is necessary to make a careful analysis of all the major economic conditions. This duty falls to the lot of management, and if properly done it means the first step in overcoming industrial waste, 75 per cent of which is now attributed to inefficient management.

The committee of the American Engineering Council defines waste in industry as "that part of the material, time and human effort expended in production represented by the difference between the average attainment on one hand and the performance actually attained on the other." The sources and causes of waste are classified by them as follows:

1. Low production caused by faulty management of materials, plant equipment and men.
2. Interrupted production, caused by idle men, idle materials, idle plants and idle equipment.
3. Restricted production, intentionally caused by owners, management and labor.
4. Lost production, caused by ill health, physical defects and industrial accident.

To this list should be added the waste caused by locating plants in communities not properly adapted for them, resulting in high cost of production and sometimes ultimate failure, all of which must be paid for by the public.

The first charge of industrial managers is proper plant location. This factor satisfactorily taken care of is a step forward to success.

Influence Which a Proposed Industry Will Have on the Community to Be Considered

Such necessary conditions to be met as raw materials, transportation, markets, labor supply, etc., are of no more importance than a full consideration of the influences prevalent in the community, in so far as they relate to industrial development and the influence which the proposed industry will have on the community. Any number of localities are seeking new factories and offer many attractive inducements. Frequently these inducements include a free tract of land in the section set aside for plant development. The industry moves in, becomes established, starts the manufacture of its product. Then the community wakes up to the fact that instead of having an asset it has a liability, for the reason that the fumes, dust or odors arising from the manufacturing processes become obnoxious to the people of the community and they sometimes declare them a nuisance, which results in loss of production and thus creates an industrial waste.

The writer has in mind three large chemical industries which were improperly located for the reasons stated above.

The first of these three was very properly placed near its source of raw materials and later a town grew up practically surrounding the plant. The town builders in this instance were at fault, as the town could have been located at a sufficiently great distance from the plant to avoid the annoyance caused by the dust.

The second of these industries was located in a section of a town which was building up rapidly and the fumes from the sulphur compounds that were manufactured soon became a marked nuisance. The management was decidedly at fault in this instance, as it must have known that the odors from the plant would not be welcomed by the community.

The third industry selected a large site near a growing town, with a full knowledge on the part of the management that sooner or later its presence would not be cherished by the citizens of the town, and it so happened that the "city fathers," in their zealousness to promote industrial expansion, asked few if any questions as to the products to be manufactured other than that they were told the textile plants took a goodly portion of their finished wares. The odors from this plant and the fact that large quantities of explosive and flammable materials must be carried in stock create both a nuisance and a hazard to the community. Sooner or later someone will demand an investigation which may result in loss of production.

With proper care and foresight so-called undesirable chemical industries can select locations relative to towns or cities that will result beneficially to all concerned. This class of industries, as well as all others, owes much to the community in which they are located. They are an integral part of the community, no less so than the churches, schools, stores, theaters, etc. They must get the proper viewpoint in their relation to the community, and the converse of this must prove to be true, and when this is accomplished then a great deal of the prevailing industrial waste will cease.

Source and Permanency of Raw Materials

The source and permanency of the raw materials is usually one of the most important controlling factors in deciding upon a location. A dependable supply of the proper quality of raw products must be assured.

I have in mind a plant built in the East, designed to reclaim a certain waste material produced by the large brass mills in the same general territory. The plant

was located near the source of its raw product and was operated profitably. The management decided that the same type of plant, though of smaller capacity, located in a city in the Middle West would also prosper. They failed to ascertain the amount which could be had of their raw product nor did they inquire with sufficient care into the location. As a result it proved to be, first, so far from their factory that they could not afford to pay the heavy transportation charges, and second, the amount of raw material available was not sufficiently great to permit operating their plant to capacity even though it could be economically assembled. This particular plant was a financial failure from the day it was completed and the whole blame lies at the door of the management in failing to make a thorough and proper analysis of their most important raw material.

Transportation Facilities

A number of large and important industries operating today are feeling the pinch of freight rates on their raw materials. When the present sites were selected the raw materials were, in most instances, relatively close at hand. These sources have, in a great many cases, become exhausted and the industries are now forced to go great distances for them, which means competition with plants making similar products located near their basic materials, and competition grows keener each year.

The markets for the finished product is a factor of prime importance, but inasmuch as they are usually scattered, the relative proximity to the producing factory is not, as a rule, of as great importance as the source and proximity of raw materials. The carrying charges on finished articles, while generally higher than on raw products, do not aggregate as much, in most instances, as they are shipped in smaller quantities to the ultimate consumer.

Transportation facilities are important from the standpoint of permitting, in most cases, the assembling of the raw materials and the distribution of the finished ware in the most economical way.

If possible, a location should be selected which permits the raw materials to be assembled by the shortest hauls, thereby taking advantage of minimum freight rates and the distribution of finished articles over the most direct routes.

Labor Supply

The question of labor supply is one that receives more attention than perhaps any of the others in deciding upon a proper location for a factory. Some managers contend that the small community offers the best inducement for contented labor and minimum labor turnover, and while the supply is not so great or so flexible as in the larger centers, production can be maintained at higher levels and accomplished at lower costs.

In my opinion the smaller communities offer the best inducements for labor providing certain essential factors are carried out so as to make the labor contented, such as suitable homes built in attractive designs and on lots sufficiently large to provide space for lawns and vegetable gardens.

The plan of building a string of company houses all of the same design does not make contented labor. The quality and design must be such that the workman will have a desire to purchase, and arrangements must be effected to enable him to make the purchase by paying a small initial sum, followed by monthly payments within the limits of his earnings.

Along with the housing development must be provided recreational centers such as baseball fields, tennis courts, moving picture theaters, good schools and churches. Conditions of this kind will obtain and hold highly skilled workmen as well as unskilled workmen.

Industrial communities built up in this manner permit the workmen to have a voice in civic affairs and thus intensifies their interest in their work and in their homes.

Power Supply

The experiences of the coal shortage a little more than a year ago are fresh in the minds of all industrial managers. Never before has the matter of power been so forcibly brought to the front as a tremendous factor in production. As a result of this experience proposed industries consider most carefully locations in their relation to adequate coal supplies and other supplies of power. Hydro-electric developments are now being considered which heretofore were thought to be out of the question as requiring too much money for their installation. This type of power source will make remarkable increases during the next few years. Big central generating stations designed to furnish power to a number of plants in their territory will be built up in greater numbers in the near future. Power-generating units, though more costly in design than in past years, will be installed in increasing numbers on account of their greater efficiency, thus tending to lower the cost of power. The essential point is the nearness to the coal mine of dependable quantity and quality, except sites that offer power from hydro-electric stations.

Climatic and Other Factors to Be Considered in the Selection of Power Sites

The size and topography of the proposed site are important from the standpoint of permitting expansion and affecting the cost of building.

Climatic conditions have a direct bearing on the speed with which labor accomplishes its work and on the cost of living. The colder climates require more and heavier clothes and a greater amount of fuel for the winter months than would have to be provided in a warmer climate, thus necessitating somewhat higher wages.

The advertising value of a plant site may or may not be an economic factor. It is believed that the public can be induced to purchase wares of merit by proper advertising and that the home of the manufactured article has very little effect in an advertising way.

Decentralization of industry has its advocates, and not without reason. There is greater flexibility to be had, both by the management and by labor, in communities that are not crowded due to a number of big industries being situated close to one another.

Sociological conditions are far better in the less congested districts and, as a rule, there are fewer laws to contend with which tend to stifle industry.

It is believed that industrial engineers in general will do well to prepare a list of certain conditions to be met in selecting the proper plant location.

A great many data are now available from numerous sources, but these have not been compiled in a systematic and orderly way. Such a compliation would be of great help to chambers of commerce, industrial agents and others interested in recommending sites for industries. The right kind of information would stop further industrial waste due to improper plant location.

Corning, N. Y.

Reduction of Waste Through Accident Prevention

The Chemical Industry in Many of Its Branches Is in the Development or Quasi-Experimental Stage in This Country—It Is Therefore Important That Its Industrial Accidents Should Be Carefully Analyzed

BY L. A. DEBLOIS
Manager, Safety Section, E. I. du Pont de Nemours & Co.

IF THE chemical industry of the United States is to compete successfully with the longer experience and the cheaper labor of European countries, it is admitted that the highest operating efficiencies must be attained and the greatest economies effected; in a word, waste of time, labor, power and material must be coaxed down to the irreducible minimum, without sacrifice of quantity production and with constantly improved quality. To achieve this irreducible minimum it behooves us to subject every possible source of waste to the closest scrutiny and to consider well before it is rejected as unavoidable or too trivial for our attention. In fact, the terms unavoidable, trivial and "inherent to the industry" should be regarded with suspicion, as possible spurious currency, until their true value is proved.

Accident Prevention a Matter of Utmost Concern to the Chemical Industry

No one denies that accidents cost money, though many reckon their cost only in terms of liability insurance premiums. Their bearing on the available man power of the country was emphasized during war-time labor shortage, but in these times of glutted labor markets it has lost much of its former significance, and yet accident prevention is, or should be, today a matter of utmost concern to the chemical industry. It is not, however, that the Europeans have progressed farther in accident prevention measures than ourselves, but that to overcome other of our competitive disadvantages we should excel them in this field at least and profit by the economies that will result.

Impediments to Accident Prevention

There have been two great impediments in the onward march of what accident prevention enthusiasts are pleased to call "universal safety": First, a lamentable failure to measure the far-reaching consequences of the average industrial accident, and second, the sublime and childlike faith of the human race in its own interpretation of what is "luck," "chance" or "Providence" as applied to accident occurrence. The first has led to an indifference to accidents which appeared of minor importance at first sight, but which were actually of profound significance in their bearing on industrial conditions; the second has persuaded us that many accidents are unavoidable or are caused by an inherent hazard or are mere chance occurrences when quite the contrary is true.

Most of us are inclined to regard accidental injuries as merely affecting the health and prosperity of the injured person and his or her immediate dependents, or, when liability for the accident is involved, the possible expense and annoyance to—in the case of industrial accidents—the employer. Under this point of view the accident with its train of consequences is commonly regarded as a complete episode, disagreeable, happening rather unexpectedly and not closely associated with the normal efficiency and routine of the industry in which it occurs. This is the everyday, every man point of view; but of late there has been developed by safety engineers a notably broader conception of the situation which promises to exert a powerful influence on the detection and reduction of industrial waste and inefficiency.

Elimination of Circumstances Contributory to Accidents Leads to Increased Efficiency

The new conception regards the nature and extent of injury as relatively unimportant, except of course for its humane aspects and in so far as it affects the cost of compensation. In fact, it regards it as being largely fortuitous: a man may be slightly injured or he may be killed under almost identical conditions. The impor-

tant matter is the train of circumstances that led up to the accident causing the injury. This can be made clearer by selecting an example. Let us assume that an elderly employee has been injured by a fall while in transit between buildings. Relatively the extent of his injury makes little difference. Investigation, however, reveals that he followed the usual route taken by the other employees and that there was ice on this path. Investigation further shows that other employees passing that way slipped but were agile enough to avoid a fall; or walked more cautiously; or went around the icy place. Whether they slipped, or slowed up, or detoured, their transit between buildings took an appreciably longer time than if there had been no ice there. By stop-watch the trip took four and one-half minutes instead of the normal four minutes. The ice was momentarily lowering their efficiency 12½ per cent. This was the real lesson in the accident; the injury to the elderly employee was not a mere unconnected episode, but a warning of the existence of conditions leading to inefficiency. We remove the ice, then, not alone to prevent accidents but also to allow our employees to proceed on their way without loss of time—loss perhaps insignificant in each individual case, but in the aggregate worthy of our attention.

Elimination of Accidents by Improving the Equipment

We may select as another illustration the operation of a battery of power-driven presses into which the raw material is fed manually by the operators. Three of these men have had their fingers caught by the descending dies and amputated. We may provide guards to prevent these accidents or we may adopt an automatic feeding device. The latter is selected and applied, the actual speed of the machines remaining unchanged. A month's trial demonstrates the fact that not only have we eliminated the accidents but we have increased the machine output 15 per cent. This latter result was somewhat unexpected and at first we are inclined to attribute it to the saving of time formerly lost through injury. That we have saved this is true, but it is not nearly enough to account for the increased output. Finally we reach the conclusion that the injuries were, after all, only the result of inefficient conditions of operation, quite unrecognized by us at the time, and that when they were eliminated the inefficiencies were eliminated also, unconsciously but effectively. Between the two was a subtle but definite relation. We conclude that inefficiency produces accidents occasionally, near-accidents frequently, and waste continually.

Probabilities of Accident Occurrences

And now concerning the "providential" side of accidents. A close study of almost any single case invariably reveals a considerable number of circumstances contributory to the accident, but so inextricably interwoven with what we may call the primary injury causation (the act that brought about the injury) as to be in reality co-operative rather than contributory. The simultaneous occurrence of each of these contributory circumstances was essential to the occurrence of the accident, although all varied in their relative importance. Out of such a study we come quite naturally to the conclusion that a certain accident will always take place when all factors necessary to it occur simultaneously. It then becomes only a question of their simultaneous occurrence. If one factor, or contributory circumstance, has a probability of occurrence of one in ten, and another has a probability of one in one hundred and the accident itself requires the simultaneous occurrence of both, it will occur inevitably once in one thousand times. There is nothing "providential" in this, no element of chance or luck any more than in the application of a match to a keg of gunpowder, and the sooner we lay aside such supposition the faster we will advance along the road to universal safety.

Foremen's Part in Preventing Accidents

The injured workman is very generally blamed for 60 to 75 per cent of the accidents. Undoubtedly he might have done something in most cases that would have prevented the accident from happening, might have exercised a little more care or forethought. But the important question for the employer to answer is what could he, the employer, have done. It is his productive efficiency and plant morale that are suffering by accidents, and to a degree far out of proportion to the mere injury. To whine about the responsibility of the workman is not mending matters. What kind of supervision are he and his foreman maintaining that injuries are allowed to occur at all? Are these foremen not part and parcel of his staff and subject to his influence? Injuries mean waste, and if this sort of waste is permitted by them, why not other sorts?

Waste and Inefficiency Precede Accidents

Probably the most frequent variety of injury occurring at all chemical plants is to the eyes from the entrance of foreign particles, often of acid or caustic. These accidents are commonly attributed to the failure of employees to wear the protective goggles that the plant provides for their use. Reasonably satisfactory goggles for practically every purpose are now obtainable and once provided it is squarely up to the manager of the plant and his staff, including the foremen, to see that they are worn. The usual excuse is "but my men won't wear them; they say——," etc. What nonsense! Would the management tolerate for an instant their refusal to mix or handle the raw materials or finished product in the way specified? The fault lies with the management, which is half-hearted in its insistence that goggles shall be worn and is inclined to blame the men for accidents which happen when they are not worn. It is absolutely within the power of any capable foreman to maintain the proper use of goggles, provided he has the expressed support of the plant manager.

But there is another angle to all this. It is quite proper that the eyes should be protected from the entrance of drops of acid and particles of caustic, but what are such materials as acid and caustic doing outside their proper pipe-lines, containers, etc.? These materials are valuable, and though the tiny drop or particle in question has an infinitesimal value, it was not the only drop that fell or particle that flew. Examination may show that considerable acid got away through the leaky gasket before any accident occurred or that considerable caustic was regularly wasted by the clumsy method of breaking up the solid caustic with a pick. If tanks are leaking, if repair men are not draining pipe-lines before breaking joints, if valve-gland packing is blowing out, if there are loose ingredients on floors and platforms, if mixing tanks are overflowing or splashing, if there is dust in suspension or dense fumes are liberated, then waste and inefficiency

are at work and accidents, the inevitable warning of the existence of such conditions, are taking place. The use of goggles will protect the eyes and save a man from total blindness—as it has done in hundreds of authenticated cases—but it will not greatly decrease industrial waste or inefficiency.

Fallacy of "Unavoidable" Accidents

Not only are satisfactory goggles obtainable, but special protective clothing, including gloves, helmets, aprons, boots, safety carboy carriers which permit one man to do safely the work of two, carboy inclinators, safety acid jugs, sample bottle carriers and other devices. And yet with all the improved protective appliances, disabling and distressing accidents from acid and caustic continue to occur by hundreds, and many are classed by those who are themselves directly responsible for their occurrence as "unavoidable" or due to "inherent risk of the business."

There are two major classes into which these accidents may be divided—operating accidents and repairs accidents. Both classes may be diminished by better supervision in the operating field and by better supervision in the drafting and design departments. Many a careful repair man suffers an injury as the indirect result of parsimonious provision of inadequate space for routine and periodic repairs or the failure of the design engineer to give serious consideration to the need of such repairs—repairs as important and as inevitable on a chemical plant as the operation of the plant itself. Many an operator is injured as result of this same want of forethought, imagination or operating familiarity on the part of the design engineer or draftsman, who has utterly failed to consider matters of accessibility, adjustments, cleaning, oiling, etc. Behind them all, and properly sharing a proportion of the liability, is the manufacturer of machinery who, in order "to meet competition" or because "there is no demand from trade" fails properly to guard his product or provide for safe adjustments and repairs.

Take, for example, the common filter press. A few types are provided with gear and pinion or worm and gear setting-up devices, but the majority depend on the archaic—or at least Archimedean—bar and screw. It is not an uncommon experience in a chemical plant to see four or five men straining on these heavy bars, which are apt to slip from their sockets when rotated below the horizontal. It is safe to say that hundreds of men have had their feet crushed, legs broken, hands smashed or have been ruptured in this way. With a geared setting-up device, one man or at the most two men can do the work of four—and with safety.

Supervision for Safety Needed in the Purchase of Equipment

It is evident, then, that supervision for safety in the purchase of equipment is as important as supervision in design. Guards for exposed gearing are frequently supplied only as "extras," sawguards do not come with circular saws, essential quick-stopping devices are not given gratis with mixing rolls and calenders, and belt-shifters are not generally provided with an automatic locking device. The general design of the equipment should be scrutinized. The square-head jointer is still on the market. Some years ago one of the leading pump manufacturers turned out a plunger-type boiler feed-pump that was admirably adapted for cutting off the fingers of power-house engineers—and did its work cleanly and efficiently—and only recently we encountered a boiler blow-off valve made by a reputable manufacturer so arranged that the bolts which held down the bonnet could come off while blowing down the boiler, and in fact did so. One wonders sometimes how much thought the manufacturers give the accident prevention question nowadays!

Prevention of Accidents During Repair Work

There is no doubt that the matter of plant repairs is an important one from the viewpoint of accident possibilities, particularly where there is a high degree of hazard in the materials of production. All too frequently there is no definite rule laid down by the management as to the relative responsibility of the operating foreman and the repairs foreman, and in default of this they are at loggerheads. The operating foreman should be the one man intimately familiar with the peculiar hazards attached to the matters under his immediate charge and should be charged with the general safety of repair gangs at work in his area, not to the extent of interfering with individuals but as advisory to their foreman. A recent serious accident involving three men overcome by fumes while making repairs inside a tank would have been avoided had the repairs foreman warned the house foreman of his intentions.

Also the repairs foreman, for his part, should not accept with implicit faith statements that all tanks are clear of fumes, that valves are closed, that pipes have been drained and are free from pressure, that switches are open and electric lines are dead, that "no one's going to open that valve, or start the motor, or throw the clutch." For the protection of his men he must quietly assure himself of these things and place padlocks, warning signs or blocking where they are necessary, and in doing so he must not take risks to which he would not subject his own men. There are also the after-accident precautionary measures to be attended to—the goggles and rubber gloves, the gas masks and life-lines, the bucket of water at hand in case of an acid or caustic splash, the location of the nearest water-shower and the condition of exits in case of a flash-fire or explosion. All such matters require careful supervision and constant drilling of foremen, but results will be found to pay for themselves. We should remember that the repairs foreman is rather an important factor in plant operation.

Safety Boosters' Clubs

The photograph heading page 403 shows the mechanical department of the Repauno Works of the du Pont company grouped beneath a sign which reads: "Something to Crow About; 590 Days Without Accident; Average Number of Men for the Year—160."

They finally completed 776 days without a single lost-time accident, though the department contained practically all the repairmen of the plant. This shows what can be done. And it is indeed amazing how the spirit of accident prevention, once awakened in foremen and men, does not die. The foreman of an average force of 643 construction men formed a "Safety Boosters Club" with the motto "Ninety Days or Bust." They "busted" twice, but finally reached their goal in the face of a 67 per cent labor turnover. In the whole period of 305 days there were only five accidents, an aggregate loss of 168 hours and a total cost of $6. One combined explosives and acid plant, averaging about 250 men, has recently accomplished an unbroken record of fifteen months without an injury (five years ago

it averaged forty-eight lost-time injuries a year) and now seriously declares its intention of establishing a five-year record of freedom from accidents. Surely such men as these have lost all confidence in "luck" and have set up determination in its place!

Prevention of Accident From Industrial Poisoning

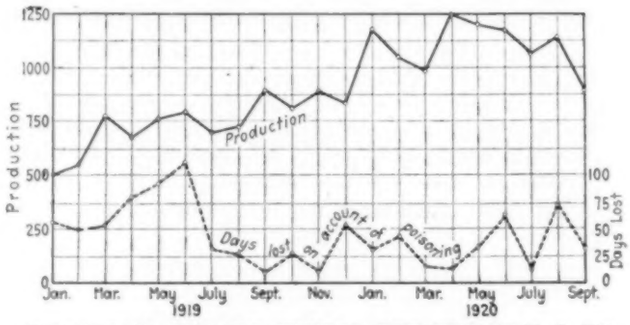
In some branches of the chemical industry industrial poisoning from the ingredients or finished product introduces a special hazard even greater than that of injury by accident. This is particularly true of the dye industry, in which the possibilities of severe poisoning under careless methods of manufacture are legion. Associated with these are special hazards of explosion from excess pressure brought on by chemical reaction, explosions by virtue of rapid chemical decomposition, dust explosions, fume explosions and flash fires. Often the small-scale chemical manufacturer, the experimenter or the byproduct tyro discovers this to his cost and loss. The larger manufacturer, who has learned lessons from his earlier experiences, develops his processes through the laboratory stage, through the "semi-works scale" to the final full-scale equipment, which is itself for a long time changed and improved, but always with an eye open to accident and poisoning possibilities. Careful chemical supervision is of course necessary, but also careful safety and medical supervision. Production foremen and supervisors must not concern themselves solely with matters of quantity and quality, but must be constantly impressed by the management with the almost paramount considerations of safety to life and health. They must be made to feel that these matters cannot be left solely in the hands of the safety inspector and plant doctor. They must realize their own responsibility and accountability.

Personal Cleanliness

Personal cleanliness on the part of plant employees is the *sine qua non* of the control of industrial poisoning, and it must be continually checked. To provide the facilities is not sufficient; their use must be encouraged and, if necessary, enforced. With this must go constant medical supervision, not of the variety that waits for patients to arrive with its feet upon the therapeutical desk, but the sort that goes forth, sees the men at their work, calls them by name and acquires their confidence. These, however, are prophylactic rather than curative measures. Poisoning may still occur and yield only to radical changes in equipment or methods. "But think of the expense—we have no money for changes!" Nor have you money to pay sick labor that is non-productive, to pay hospital bills, to pay funeral expenses and compensation for dependents. "Yes, but we don't pay for those, the insurance company does that." Quite so, but what do you pay the insurance company—1 per cent of your payroll, or 2 or possibly 4? In 1920 the du Pont company took care of its injured men on a more liberal scale than provided for by the state compensation acts at a cost of about 72c. per $100 of payroll, which included medical, surgical and hospital costs and salaries of safety men engaged in compensation and settlement work. The estimated saving through self-insurance and accident reduction was sufficient to pay for all accident prevention work, both structural and educational, the salaries of safety departments at the plants and in the main office, and leave a net balance of 64 per cent as profit on the year's work.

Beneficial Results of Accident Prevention

In the past ten years 75 per cent decrease in the severity of accidents has been attained in the plants of the du Pont company. To what extent this has effected productive efficiency it would be impossible to say. It has doubtless had its effect; though no well-defined line can be drawn between industrial waste and waste by accidents. It will, however, be of some interest to the readers of Chemical & Metallurgical Engineering to



INDUSTRIAL MALADY CURVES, DYE WORKS E. I. DU PONT DE NEMOURS & CO.

note a corresponding effect in the case of industrial poisons.

Coincident with the changes in equipment and methods in the manufacture of trinitrotoluol—one of the first industrial poisons encountered by the du Pont company—the following results took place:

	Per 1,000,000 Lb. Handled in Manufacture	
Year	No. of Cases	Hours Lost From Poisoning
1914	11.	391
1918	0.2	11

And among the more varied ingredients and products of the dye works, the time lost on account of industrial poisoning decreased in 1920 39 per cent as against 1919; while the production in pounds, by virtue of changes, improved methods, etc., increased 47 per cent, giving in one year a net decrease of 58 per cent in number of days lost per unit of production.

Whether accident prevention and disease prevention promote productive efficiency or more efficient methods reduce accidents and poisoning is immaterial, so long as one recognizes the inseparable relationship that exists between them.

Wilmington, Del.

Responsibility of Owners in Waste Elimination

The owners of industry, through the banking function or otherwise, share in the responsibility for eliminating waste in industry. They have the duty particularly of assisting in stabilizing production. Carrying out such a policy is peculiarly the banker's interest. This is the conclusion reached by the Committee on Elimination of Waste in Industry of the Federated American Engineering Societies as stated in the summary of its report, July, 1921.

While it is true that balance sheets and income statements are gages of the degree of success of a business, it is evident from the assay of waste that these statements often do not reveal all or even the greater part of the facts regarding production. Certain banks have special industrial staffs to give service to their customers and to study industrial questions more closely. It may not be long before such things as good management methods are universally recognized as commercial assets.

Elimination of Waste in Industry Due to Poor Lighting

Industrial Accidents and Resulting Wastes of Man Power as Well as Costly Losses of Time, Materials and Production Can Often Be Avoided by the Installation and Proper Maintenance of Adequate Illumination

By WARD HARRISON
Illuminating Engineer, National Lamp Works

A CHEMICAL plant is a conspicuous example of an industry in which a large proportion of the work is necessarily carried on throughout the twenty-four hours. Consequently dependence must be placed upon artificial illumination for fully one-half of the time. More than this, many of the plants connected with the industry are so constructed that there is very little window space in proportion to the total floor area. In order to avoid an atmosphere of gloom and of dark areas where unseen dangers may lurk, and to keep such a plant clean and orderly, it may be necessary to use artificial light during the greater part of the day. As a rule a high level of artificial illumination over the large areas is not necessary, because the work does not involve fine discrimination of detail except at the gages, hydrometers, etc., where special lighting is usually provided. On the other hand, it is desirable to provide at least a moderate amount of illumination throughout the plant for the reasons mentioned above, and particularly in order to protect the workmen from accidents.

The opinion is often expressed by the layman that a greater amount of artificial light is used than necessary. Frequently he believes there is as much illumination in a brightly lighted room as there is in daylight out of doors. The facts are, however, that out of doors one may measure 500 to 1,000 or even 5,000 units of light. Indoors near the windows perhaps 100 units and less than 10 units anywhere is scarcely considered a good working light in the daytime. Often the night illumination in the same plants is around 0.1 of one unit of light (or 0.1 foot-candle as it is called). From 3 to 6 foot-candles is not too much for the general illumination of a chemical plant.

Accident hazard is particularly great in dimly lighted chemical plants. Obstacles may lie on the floor unseen until someone stumbles and is injured. An acid drip may go unnoticed, or the light may be so dim that the label on a dangerous chemical cannot be distinguished. The proverbial dark corner, however, does not exist in the case of a well-planned lighting installation in an interior with light colored walls and ceilings. An effective means of keeping corners clean and empty is to paint them white.

Industrial Accidents Caused by Poor Lighting

The largest item of waste in industry of which we have definite knowledge is the waste of man power due to accidents; and the chemical and steel industries are no exception in this respect. Regarding the relation of waste and accidents one can do no better than to quote directly from an article[1] by R. E. Simpson of the Travelers Insurance Co. "It has been definitely established that ten years ago approximately 24 per cent of our industrial accidents were caused by poor lighting. In the intervening decade much progress has been made in the art of illumination and in promoting the safety of workers, with the result that this percentage has been considerably reduced. . . . If we admit that 15 per cent of our industrial accidents are due to the misuse of light sources what does this represent in financial and economic loss? . . .

"Our conception of the total economic loss that the foregoing figures involve will depend largely upon the unit costs with which they are associated. If we conservatively estimate $20 as the average weekly wage and assume that $20 per week is needed in addition to cover medical attendance, hospital charges, loss in production, insurance and the various other items that enter the cost of an accident, we find the total annual cost, in round figures, approximates $2,000,000,000, the part chargeable to poor lighting therefore being about $300,000,000. This is a sum in excess of our yearly industrial-lighting bill, and hence we see that the misuse and inadequate use of lighting facilities in industry cost more than the light itself."

FIG. 1. AN EFFECTIVE MEANS OF KEEPING CORNERS CLEAN

Wastes of Time and Production

The preface to the Wisconsin Industrial Lighting Code, in explaining why the state is concerned in the regulation of factory lighting, also discusses the economic advantages of good lighting as follows: "Finally, inadequate illumination decreases the production of the industries of the state, and to that extent the wealth of its people. Factory managers who have installed improved illumination are unanimous in the conviction

[1] I. E. S. *Transactions*, vol. 15, No. 8.

that better lighting increases production and decreases spoilage."

Waste of time due to lack of supervision and discipline is also characteristic of dimly lighted areas. In such places a workman will take advantage of the opportunity which permits him to sit unnoticed in some dark corner, smoking or dozing for a while when in the meantime some important process is carried too far; in a well-lighted room such a scheme would not even suggest itself. It is a well-known fact that workmen are more contented in an orderly, well-lighted plant, and that contented workmen do more work and are more careful in their work. Order and neatness are much easier to maintain when there is sufficient light.

Wastes of Materials

A large item of waste in the chemical industry is the waste due to spoilage of entire batches of material. This is often caused by the incorrect reading of thermometers, hydrometers or gages traceable to lack of light. In plants that have a poor general lighting system and even in plants that have good general lighting, a special light is usually provided for reading gages. Bare lamps or poorly shaded lamps giving rise to direct glare should not be used for this purpose, and care should be exercised to place the lamp and reflector at such a height as to avoid reflected glare or "specular reflection" from the lamp on the gage.

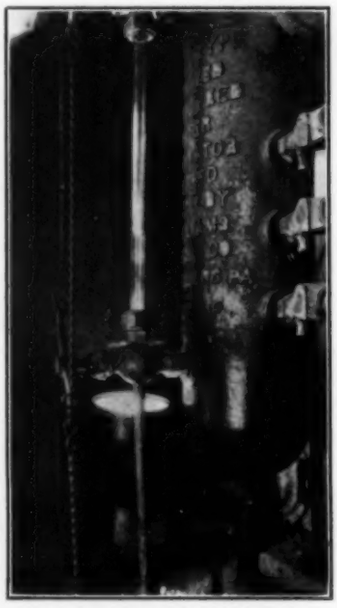


FIG. 2. ILLUMINATION OF A GAGE GLASS

Another common cause of spoilage of batches is incorrect judgment of material, which may also be due to lack of light or to distortion of color. In order to avoid spoilage of batches due to color distortion, the so-called daylight lamps may be used. These lamps are particularly desirable in chemical laboratories and sample testing rooms and in fact wherever color discrimination is necessary. There are also devices on the market which reproduce with even greater exactness almost any quality of daylight desired, such as north skylight or noon sunlight. These are for use where a high degree of accuracy in color matching is necessary.

Production and Lighting Costs

It may be of interest also to note briefly the results of some tests which have been conducted in order to determine the relation of lighting to production. In all of the efficiency tests conducted to date, the highest level of illumination investigated has invariably shown the greatest production and the greatest economy. In fact, in the range considered the relation of decreased production costs to total lighting costs is of the order of 10 to 1. Four such tests which were conducted in Chicago industrial plants under the supervision of W. A. Durgin show increases in production of 10 to 20 per cent resulting from better lighting.

During the last decade the trend of practically all manufacturing costs except the cost of light has been upward. In terms of other manufacturing costs, light now costs only one-tenth of what it did ten years ago. The cost of lighting per unit today is less than 3 per

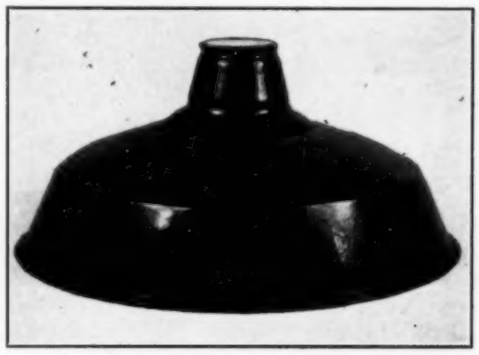


FIG. 3. RLM STANDARD DOME REFLECTOR

cent of what it was in the days of the tallow candle. This means that where a number of years ago the cost of light prohibited the manufacturer from using more than a certain small amount, necessary for actual vision, he can now afford to use many times that amount of light, in order to carry on his manufacturing operations most economically.

Equipment for Proper Lighting of Chemical Plants

A few practical suggestions as to the proper lighting for such plants as are typical of the chemical industry might be useful to those who are interested in installing a lighting system which will assist in establishing the greatest economy in the working of the plant.

As has been previously mentioned, a general lighting system is desirable, supplemented by local lighting for work requiring fine discrimination of detail. For the general illumination of the ordinary processes in this industry, from 3 to 6 foot-candles of illumination should be supplied. A type of lighting equipment which has a wide application is a porcelain-enameled steel reflector. A great variety of such reflectors have been used for industrial lighting, but some time ago, through the co-operation of the principal manufacturers of steel reflectors and the engineers of the lamp

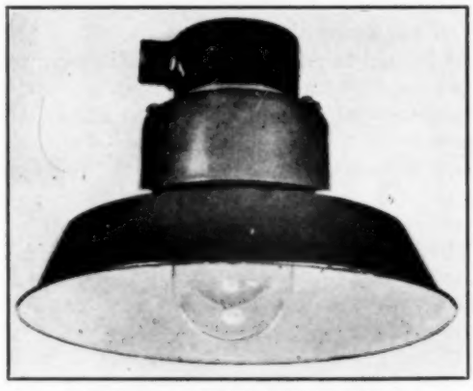


FIG. 4. VAPOR-PROOF UNIT

manufacturers, specifications were drawn up for a standard porcelain-enameled steel dome reflector which embodied the advantages of the numerous older types and which omitted many of their defects. The specifications for this design have been issued by the research laboratories of the General Electric Co., and are

known as Reflector and Lamp Manufacturers (abbreviated RLM) Standard Specifications. Reflectors which comply with these specifications bear a statement to that effect in the form of a certificate of Inspection Service over the signature of the Electrical Testing Laboratories of New York City, which has been retained to conduct such periodical inspections and tests as will insure the uniform maintenance of the high quality prescribed in the specifications.

In order to reduce glare and glaring reflections, and to get better diffusion of the light, bowl enameled

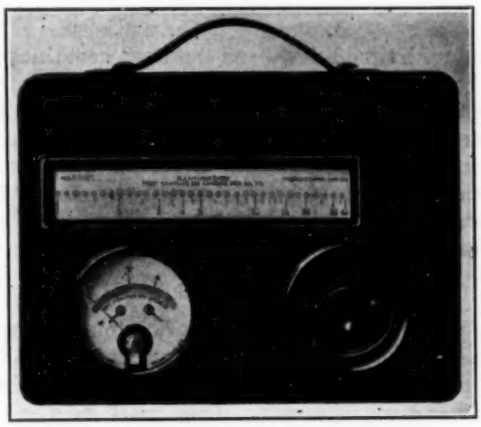


FIG. 5. FOOT-CANDLE METER

lamps are preferable for use in RLM standard dome reflectors, except when the units are hung at a considerable mounting height—for instance, at least 18 or 20 ft.

In chemical plants it is often necessary to protect the electrical connections from acid fumes and flammable vapors. Vapor-proof units of rigid construction, able to withstand atmospheric conditions, have been designed for such locations.

Maintenance of Adequate Illumination

Proper maintenance of a lighting system is a matter of great importance. In plants connected with the chemical or steel industries there is usually more or less smoke and dust in the air and the lighting system is particularly likely to deteriorate from this cause. Dirty reflectors, walls and ceilings darkened by smoke and dust, blackened lamps left in service as long as they continued to burn, empty sockets, unobserved burnouts, and replacements with lamps of wrong size or improper voltage rating are prime causes of inadequate illumination.

There are two methods by which the maintenance of any selected value of illumination can be assured: First, by allowing for an enormous depreciation in the light and consequently using much larger lamps than would ordinarily be considered necessary; and second, by maintaining the system properly and allowing for reasonable depreciation. The second, more generally practical, method involves: (1) The use of a depreciation factor, or factor of safety, in the original design of the system to insure adequate illumination when the system has depreciated a normal amount. (2) The cleaning of lighting units at frequent regular intervals. (3) The replacement of lamps which have become blackened in service by abnormally long life. (4) The use of lamps of the correct voltage rating for all replacements. (5) The refinishing of ceilings and walls at reasonable intervals.

How large an amount should be added to the intensity considered adequate, or, what amounts to the same thing, by how large a factor the intensity considered adequate should be multiplied to insure proper illumination at all times, depends upon the specific conditions surrounding any particular installation. In general, when installed in relatively favorable locations, open-reflector units show a depreciation which ranges from 10 to 25 per cent in four weeks time. Where excessive smoke and dust are the rule, the depreciation over the same period may be as high as 40 per cent. The depreciation of ceilings and walls depends not only upon the characteristics of the location—i.e., whether clean or dirty—but upon their original color as well.

Use of the Foot-Candle Meter

A device has recently been developed which will be found extremely useful in the proper maintenance of a lighting installation. This device is known as a foot-candle meter, for it measures the illumination at the work directly in terms of foot-candles. The instrument is shown in Fig. 5. With it the illumination can be read directly from the scale without computations or adjustments. In one large establishment where the superintendent uses a foot-candle meter systematically as a check on his maintenance department, readings of illumination intensity are taken at regular intervals at fixed stations throughout the plant. These readings are recorded in such a way that the successive readings are readily comparable. When any inconsistency appears in the records, an investigation is made and the proper remedy applied. The illumination in the offices

FIG. 6. CHEMICAL LABORATORY ILLUMINATED BY MEANS OF BOWL ENAMELED LAMPS IN DOME STEEL REFLECTORS, HAVING AN UPPER SECTION OF GLASS TO SUPPLY LIGHT TO SIDE WALLS AND CEILING

and important work places of this establishment is never allowed to fall below 6 foot-candles without immediate correction. By measuring light actually delivered to the work, the foot-candle meter automatically reveals the combined effect of all possible causes of depreciation.

Ignorance of the magnitude of the depreciation which follows the neglect of a lighting system has been responsible for the expenditure of many kilowatt-hours without adequate return. In other words, light saves accident and waste, but light itself, too often, is wasted.

Nela Park, Cleveland, Ohio.

Eliminating Manufacturing Wastes With Machinery

A Recognition of the Importance of Engineering Research and the Extensive Use of Automatic Machinery as a Means of Eliminating Wastes in Labor, Time and Materials—"Watchful Waiting" Policy Must Be Changed to An Offensive One

By J. E. HIRES
President, Automatic Machinery & Equipment Co.

A STUDY of the development of the use of automatic machinery in manufacturing plants reveals a tremendous revolution in methods and processes in the last century that can be outstripped only by the still further improvement which inevitably must come in the next. From the invention of the cotton gin, to which all of our schoolday American histories point as the beginning of modern industrial methods, to the present-day slogan of many of our food manufacturers—"Not touched by human hands"—there lies in every industry a trail of obsolete machinery and equipment that has furnished many a meal for the scavenger of our manufacturing plants—the junk dealer. In some instances, so quickly have improved machines been produced and so ruthless has been the law of price based on competitive cost that new machines have superseded equipment almost new, but obsolete.

Attitude of the Manufacturer

One reason perhaps for this very condition has been the failure of the manufacturer to grasp the importance of engineering research toward the improvement of his methods. Too often he has waited for an outsider to build a machine for his business and then been forced to adopt it, after it had already been sold to his competitor, in order to enable him to stay in the business. From an improvement standpoint he has adopted the "watchful waiting" policy, with the result that better machinery has been forced on him as a defensive measure, rather than being developed and patented by him for the benefit of his own business.

This, perhaps, is too severe an arraignment of the managerial ability of our country to pass over without some comment on the other side. It is true that the average manufacturer has found his hands so full in producing his own goods that he has had neither the time nor the capital to spend in building machinery for the production of those goods. It is also true in times such as the "cost-plus war period" just passed that the manufacturer has been more concerned with immediate results than with the building of machinery that will save something six months hence. But in times of depression, such as the present, every avenue of cutting costs must be followed out, and incidentally in nine times out of ten the machinery which is designed and built for the purpose of cutting costs has the added advantage of greatly increasing the capacity for production during the busier days ahead.

Lack of Designing and Engineering Staff

Another big handicap in the manufacturer's path has been the lack of the expert designing and engineering staff which is required to build the needed machinery. He may have and often does have mechanics of ordinary ability, with good ideas as to how certain processes could be done to better advantage, but they do not have the broad experience in the designing and building of automatic equipment which will bring those ideas into actualities. Furthermore, he cannot find in the average machine shop, that does a general repair and "build-to-specifications" business, the caliber of men who can solve his problems.

Co-operation in Developing Machinery

The designing and building of automatic machinery is in a way a business in itself, and yet it is a business which must be closely linked up with that of the manufacturer whom it serves. This must be the case for two reasons:

First, the manufacturer must be assured that he will receive the benefit in the way of "patent rights" of any machinery built for him, because after all he or his men will contribute many of the ideas embodied in the final machine. He will give, in other words, the intimate knowledge of the requirements of the business and the idea of what is to be accomplished, while the designer and builder of the machinery, acting in the capacity of consulting engineer, brings to the problem the technical knowledge and skill required to solve it and the broad experience in the construction of similar equipment in many other lines. There is undoubtedly a timidity among some manufacturers toward allowing anyone from an outside company to become acquainted closely with the manufacturing processes in their plants. There is, perhaps, a feeling that their methods are to some extent secret and a fear that ideas gained by an outsider may be carried to competitors in the same line. However, this is not the case in dealing with a reputable company, which is making a specialty of just this kind of business and whose whole business naturally rests upon its careful guarding of its client's interests.

Second, it is only in this manner that the average manufacturer can reasonably approach such a problem. He cannot afford to hire the men or purchase the equipment to design and build his own machinery. The volume of his work would not justify the expense, for men who can do this work cannot be hired at ordinary mechanics wages and some of the equipment required will not be found in the ordinary machine shop. And yet it must not be thought that there is anything mysterious in the perfecting of labor-saving machinery. There is nothing in the business of equipment designing and construction akin to the popular conception of the inventor, producing through divine inspiration or black magic a completely new world wonder. On the contrary, the rules of the business are as simple, the methods as direct, and the results as sure as that of any

other business. Whatever is accomplished is based on something already accomplished. Very often the most valuable work of a consulting engineer in this capacity is simply improvements on present machines, and furthermore many of apparently the most wonderful new machines are based on other machines that have failed. It is simply a question of remedying a defect here or adding an improvement there, which turns failure into success and changes a junk heap into a machine "that almost seems intelligent."

Saving in Labor, Capital and Overhead

There are certain underlying principles which govern the use of machinery that apply to any manufacturing plant, whether it is making thumb tacks or caramels. These are certain points for which the consulting engineer looks when he enters a plant. The most common idea of automatic machinery is that it is a labor-saver, and it is possible that the greatest saving lies in that direction, although in many cases an even larger saving may be made in materials. For instance, a sirup-filling machine was constructed primarily with the idea of replacing six girls filling by hand with one man operating the machine. The saving made in labor was perhaps $15 per day per machine. But the greatest saving of the machine was in the elimination of waste due to overfilling and underfilling by the hand method. Short-fills were eliminated and instead of cans going out with one-half ounce too much sirup in them, the net weight could be accurately adjusted by the filling machine to within three one-hundredths of an ounce. Figuring one machine turning out 60,000 cans per day, this meant a saving of 30,000 oz. of sirup, or 1,875 lb., valued in this instance at 10c. per lb., or $187.50 per day saving. Very often, too, there is a considerable saving in capital as well as operating expenses.

The substitution of mechanical for hand labor invariably means greater production in less floor space. It may mean the dropping of plans for additional buildings which were considered necessary in order to increase production, for in any case where hand labor is used increased production is obtained only by more help, and more help means more room, more boilers, more rest rooms, more office force to handle the larger payrolls, or, in general, more overhead. Another tremendous source of saving is in the elimination of carrying skilled employees over periods of depression in business, simply because they have become so necessary that they must be retained until business picks up. In many industries hand labor is used in processes where it requires months or even years of apprenticeship before an employee becomes efficient. If these employees are discharged in a time of depression the loss to the business in starting up again is often greater than the loss of paying the employees during the idle period.

Continuous Manufacturing Operations

One of the most common sources of inefficient operation in the manufacturing plant is the lack of continuity in the process. The product starts in one department and has something done to it. It is put down, picked up and trucked to the next department, where something else happens to it, and so on through all the departments of the plant. It may spend days, weeks or months in its journey through the plant, sidetracked at some junction point, just as our freight cars were sidetracked when a troop train went through, and each time it is sidetracked it is put down and picked up again. Many machines which are not continuous in their operation can be found in plants where the speed of production is determined altogether by the operator who sets the machine in motion and stops it at each operation, and very often with some comparatively slight adjustment those machines can be made to operate continuously and be fed automatically, so that their production is predetermined and not dependent on the personal feeling of the operator. The ideal operation of the plant is a continuous one, from the receipt of the raw material to the loading of the finished product into the freight car, without stopping at any stations en route, where the track might be blocked by an accumulation of stock from the shipment ahead that for one reason or another did not get out on time. This means, of course, the careful co-ordination of the work of different departments. It means the reducing to a common denominator—or, perhaps better, the increasing to a common denominator—of the speed of the process in each department and the installation of carefully planned conveying equipment, which will keep the product moving continuously from process to process at the right time throughout the plant.

Use of Automatic Equipment

Generally speaking, there are certain processes in almost every plant which can be handled automatically, and the perfecting of the equipment to handle them is usually confined to modifying existent plans, so as to meet the special requirements of the individual product. For instance, the filling of liquids into cans or bottles can be accomplished continuously on the rotary principle. The size of container to be filled, the density and viscosity of the product to be filled, all will have a decided bearing on the details of the machine. It is true that if the liquid to be filled is a food product, some special precautions from a sanitary standpoint will have to be taken in the construction of the machine that would not apply if the liquid to be filled were paint or oil, but, again, that is a detail which will not alter the general principle. Similarly the labeling, wrapping and packing of goods, and the conveying of goods in process and finished product can all be accomplished automatically regardless of whether the product is olive oil or soap, camera films or patent medicines, with due allowance being made for the difference in size, shape and weight of the particular packages to be handled.

Interesting Industrial Applications

It is interesting to note some of the particular applications in modern industry. There is the nailing machine for example, which at one stroke makes a completed box as fast as a man can drive a single nail. There is the automatic ticket printing machine, which has taken the printing of theater tickets out of the hands of the local job printer, because he could not compete at twice the price with the automatic machine. In this instance an immense business has been built up based on the patent rights of one machine, that proved such a labor-saver that no other printing establishment was able to compete in its particular field.

There are sealing machines for canning factories that seal a hundred cans per minute and eliminate the labor of fifty operators soldering by hand. Forty per cent of the cost of manufacturing calendars today is in the hand labor required to collate the sheets after they are printed. A machine is now in process of development which will collate these sheets and pad them at

the rate of five hundred per minute. Moreover, the application of such machinery is not confined entirely to hand labor. Frequently it is possible to replace clerical labor by machines, such as coin counters and automatic weighing and measuring machines. There is a machine in the hide and leather industry which automatically measures the surface of a hide, of however irregular proportions it may be. So one might continue endlessly pointing out the saving of time and materials, the increase in productive capacity and the elimination of the labor problem in industry after industry that has been accomplished by the introduction of automatic machinery.

Recognition of Engineering Research

The function of this article, however, is to point out the possibilities of improvement through the more extensive use of machinery and to define a reasonable policy which the average manufacturer might profitably follow in order, first, to protect himself against the possible loss of his business through his competitor producing more efficiently and underselling him, and second, to insure to himself the benefits to be derived from the patent rights of new inventions which are constantly being evolved in every line of business. To accomplish this purpose the "watchful waiting" policy must be changed for an offensive one, which starts with a budget for research engineering work and the recognition of the fact that money spent for experimental work in developing new methods and processes is a legitimate and in fact a very necessary part of modern economical production.

Painstaking Effort and Experiment Appraised by Ultimate Results

After the appropriation is set aside for this work, the next point to be realized is that the first machine built to do a given piece of work is going to cost probably three times as much as it ought to cost and three times as much as it will cost to produce identically the same machine after it has been perfected and all the plans and patterns are completed. In other words, the building of the first machine is experimental. Failures in different points will occur and must be overcome. Unexpected obstacles arise, so that the first machine will seem to cost an enormous sum compared with any other machine in the plant or even with identically the same machines which follow it. The excessive cost of that machine, however, must be considered as spread over the other machines that follow it and the money to pay that cost is to be repaid by the savings made by every one of those machines put into use. Automatic machinery cannot be produced out of thin air, or purchased to fill a given need at so much a ton. It requires painstaking experiment and effort and must be appraised in the final analysis, not by what it costs for the first machine, but by what it saves and by the advantage the patent rights give the manufacturer in enabling him to undersell his competitor.

If every manufacturer would take the attitude that the improvement of his methods of manufacture was as much a part of his business as the actual production of his goods and set aside an appropriation for this research engineering work, it is safe to say that in the long run no appropriation he makes will yield any better, surer returns.

Philadelphia, Pa.

Some Causes of Low Production

In the summary of the report of the Committee on Elimination of Waste in Industry (July, 1921), some of the causes of low production are grouped under: Faulty material control, faulty design control, faulty production control, lack of cost control, lack of research, faulty labor control and ineffective workmanship.

The average manufacturer has no calendar of operations except the dates of starting and finishing a job. He largely regulates deliveries of materials by visits to the job, or through statements received from the job superintendent. Haphazard methods of planning result in delays for want of material, or in burdening the job by an oversupply of material. Another waste resulting from inadequate control comes from the speculative purchasing of raw materials. Fortunes are made or lost in this practice.

The defective control of design results in a major waste, since it prevents standardization of product.

The lack of adequate methods of production control is evident in every industry. It is one of the outstanding weaknesses.

It is found that at least ten hours per week per man is thrown away on energy-wasting and time-wasting work resulting from lack of shop methods, while an additional two or three hours per man per week are wasted in unnecessary work. The lack of production control is not a question of large versus small plants. Some of the large plants as well as some small ones show a large waste factor.

The majority of the industrial plants studied lack a knowledge of costs and have no cost control. Therefore there is no adequate method of judging fairly and accurately when improvements are needed and when waste is occurring. This prevents prompt correction of defects.

While certain industries are ahead of the rest in plant research, the need for more intensive research activity is apparent in every industry.

The cancellation of orders is a condition peculiar to certain industries. Purchasers buying on long-time contracts return unsold goods at the end of the season, and claim and receive credit.

Labor Turnover and Inefficient Workmanship

A high labor turnover is a rough index of one of the common wastes resulting from inadequate labor management. This is an important factor of labor waste because of its magnitude and because of the expense involved in training new workers to take the place of those who leave. Employment managers are rarely employed even upon the largest jobs, and "hiring and firing" is at the will of the foreman or superintendent. Another fault in labor control is improper or inadequate rate setting. If the rate is set too high, it means unequal payments to the workers or else cutting rates later on. This policy is responsible for much of the friction in industry.

Another loss resulting in low production arises from inefficient workmanship. For much of this management is responsible through failure to provide opportunities for education or special training. Management cannot, however, do more than provide these facilities, and experience has shown that it is difficult to interest workmen in training courses which are designed to increase effectiveness. Further, much ineffective workmanship arises from lack of interest in work or lack of pride in good workmanship.

Elimination of Waste in Industrial Power Plants

Shall an Industry Own Its Power Plant or Buy Its Power?—The Determining Factor Is the Relation of Heating and Process Steam to Power Demand—The What and Why of Fuel Economy

By DAVID MOFFAT MYERS
Consulting Engineer

IT IS an interesting fact, and one little realized, that the factory power plant possesses an enormous advantage in the production of economical power, an advantage entirely lacking in the modern central station of our "superpower"[1] ideas. The fact may be very simply explained. The central or so-called "superpower" station has a single object to fulfill—i.e. to supply consumers with power and with power alone—whereas the natural and unavoidable product of every steam-power plant is not only power but heat as well. And furthermore, this product divides itself (again unavoidably) into about 20 parts of power and 80 parts of heat. These 80 parts of heat are absorbed by the cooling water of the condenser and wasted. The condenser's one object is to assist in converting the largest possible proportion of the heat of the steam into power and is necessary for this purpose. When a condenser is not used, 86 to 95 per cent of the heat is available in the exhaust for heating and about 4 to 12 per cent converted into mechanical energy.

This represents the best that can be done in actual practice in our effort for efficiency when power alone is the object sought. The waste of steam, heat and fuel to the condenser is in the average case four times as great as the useful energy produced. Natural laws have bound us to this narrow limitation, which may be only slightly improved as we learn how to construct steam power apparatus for still higher steam pressures and greater temperature ranges.

The central plant has no market for this heat, to produce which it has been compelled to consume four-fifths of its coal.

Use of Exhaust Heat for Heating Purposes

The usual industrial plant, on the other hand, has frequently a very large demand for heat as well as power. In many cases and in numerous kinds of manufacture all or the major part of this exhaust heat can be utilized for processes and for the heating of buildings. In the majority of industrial plants heat is needed for the plant during the cold months of the year. In all such industries all or a portion of the otherwise wasted heat which is a pure byproduct of their power generation can be effectively utilized to take the place of its equivalent of direct steam from the boilers. Thus, for example, in an industry where there exists a large demand for heating and process steam the economy of the situation would be represented approximately by the following comparison:

Case 1. Combination power and byproduct heating. Five to 10 per cent of the heat of the steam converted into electrical energy to supply the power demands; 90 per cent or more for heating and process work; no steam wasted.

Case 2. Power and heat from separate sources, the former from a superpower plant, the latter from a boiler plant in the industrial establishment. The boiler plant will have to produce 90 per cent as much heat (steam) as in case 1, and at the same time it will be necessary to buy power which has been made with an 80 per cent waste of steam and is consequently proportionately expensive, since the consumer must pay for the 80 per cent waste of steam as well as for the power.

Each industrial plant has its own particular requirement for so much heat and so much power, but the more heat it requires the more cheaply can it make its own power as a byproduct of its heating and process steam. There are many plants which require little or no heat. Here power alone obtained at the lowest cost is required. Whether such an industry should own its plant or buy its power is purely a question of the engineering economies of the situation.

Modern central stations can produce power more economically than the small industrial power plant when power alone is wanted. The losses over long and costly transmission lines both electrical and financial must be considered, however, in the case of central station power.

The Field for Superpower

Superpower as now conceived has its legitimate range of service and will find its appropriate and economical field of consumption in those industries, principally the medium and smaller sized plants, where the heating requirements are relatively small, and in some cases where capital might earn more when invested in factory extension for increase of production than in the building of a power plant. Then there are also many plants where the necessary heating may be largely accomplished by surplus heat from process furnaces, kilns, etc. In such the outside power may often be supplied with the best possible results.

From the standpoint of steam and fuel conservation, however, the operation of the superpower station as now planned is exactly comparable to that of an industry which throws away 80 per cent of its partly finished product. The directors of such an undertaking would not rest until some valuable market were found for turning this huge loss into profit. By the same logic a new conception is needed of what could more truly be termed superpower. Such a conception at once in-

[1] "Superpower" as produced refers to a rather large extension and improvement of our existing system of electrically connected steam- and water-power plants along the north Atlantic seaboard. It is estimated that possibly 15 per cent may be water power. Congress some time ago appropriated funds for preparation of a report designed to show the cost of executing this plan and the economies which might result. The plan aims to supply efficiently made energy for general railroad and industrial consumption with the hope of eliminating many small power plants apparently less efficient and to reduce the coal carried by the railroads by transmitting the equivalent energy in the form of electric current.

volves the necessity of a market for the byproduct heat of the power plant, and this immediately presents a picture of what has already been accomplished together with a vision of further possibilities and economies. In many industries exhaust steam has been utilized to the fullest extent, with the consequently specific economy of byproduct utilization. There are many well-tried specific means and equipment, prime movers and heating systems for effective execution of such combination of heat and power. And these of course require engineering judgment and experience in their correct selection and arrangement. The point is that such truly efficient plants have for long been a proved and accomplished fact.

Improve Central Power Stations

The next step is to improve our central power stations along the same general lines as far as possible. In large cities the stations now selling power only should revise their policies toward real fuel conservation and plan for the development of combined heat and power systems so as to furnish both commodities to present consumers. Isolated cases have already been reported and in one case the income to the central station from the sale of heat alone paid for the cost of its power production. The block system of central heat and power plants should be further developed. If modern heat and power stations could be built near large industries requiring both heat and power, great economies in steam and fuel would be effected.

Elimination of Waste in Relation to Power

It has been stated previously that superpower talk is in the air, and every factory owner and manager is concerned with its relations to his own power problem. I have therefore introduced my subject by presenting a few fundamental facts which may assist to some extent in a clearer understanding of how this power is produced and how it may or may not economically apply as a source of industrial power in any particular case, each of which must be skillfully diagnosed on its individual merits and in accordance with its local conditions.

While it is quite logical and often appropriate to begin a discussion of power plant economy with the fuel supply, the boiler plant and its generation of steam, then the distribution and various applications of the steam, I have elected a different order of treatment in this case and for this reason: In the industrial power problem both from the standpoint of operation and of design, which includes the question of purchased power, the determining factor is almost always this element of heating and process steam in relation to power demand. I am therefore placing this determining factor first with the object of getting for it the emphasis to which it is properly entitled.

It is an economic blunder of the first magnitude to use direct steam for heating or process work without first deriving from that steam its quota of mechanical or electrical energy, when such application is available. And conversely it is equally poor engineering and bad business to use steam for power generation alone when it is possible to utilize the large percentage of byproduct exhaust heat for manufacturing processes or for heating buildings.

I very often find prevailing among owners and managers the idea that low-pressure steam can be made much more cheaply than high-pressure steam, and they therefore feel that if they could eliminate their engines and turbines and make low-pressure live steam for heating instead of using exhaust from engines a great saving in fuel would be effected. As a matter of fact, at the same boiler and furnace efficiency exactly the same amount of fuel is required to supply the same quantity of heat whether the steam is at 1-lb. pressure, at 100 lb., or any other pressure. The only gain possible might be 1 to 3 per cent better boiler efficiency due to lower flue temperatures made possible by lower steam and boiler temperature.

It was formerly thought impracticable to use exhaust steam except at very low pressures. Ten- to 30-lb. pressures are now rather common. And as I write I have in mind a large rubber-manufacturing plant where a 10,000-kw. non-condensing turbine is being installed to take steam at 250-lb. pressure and exhaust into vulcanizers at 80- to 100-lb. pressure. The electrical energy so generated will be virtually a byproduct of the direct steam formerly used by the same vulcanizers as far as fuel is concerned, and its total cost per kilowatt-hour will be a very small fraction of the cost at the plant of energy delivered from a modern and efficient power station located directly at the mouth of a coal mine only ninety miles away.

Where all the exhaust steam can be used, a common old-fashioned slide valve engine will produce byproduct power in a factory for a fraction of the fuel required for the same power made by a modern steam plant operated condensing.

Extraction Type of Steam Turbine Useful

Where all of the exhaust steam cannot be used all of the time, the extraction type of steam turbine may often furnish the solution. This turbine, which operates condensing, is designed so that exhaust steam can be drawn from between the high- and low-pressure stages after doing work and producing electrical energy through the higher range of expansion. When less exhaust or extraction steam is needed, the surplus automatically passes on through the low-pressure stages of the turbine to develop more electrical energy and permits the throttle to cut down the use of the equivalent live steam from the boilers. In this way a steam balance is maintained for all combinations of heat and energy demand. There are several other methods of producing this desirable balance of heat and power without waste of exhaust steam, which can be applied in accordance with conditions and requirements.

There is also the mixed pressure type of turbo-generator. This operates condensing on low-pressure steam with provision for automatically receiving direct steam from the boilers in case the imposed load and available exhaust so require. Thus in case there exists in a plant a surplus of exhaust steam for which there is no heating demand this exhaust steam can be made to produce electrical energy.

The distribution and application of the heat of exhaust steam have become very efficient with the development of modern methods and equipment. Among these should be mentioned the vacuum return line system of low-pressure heating; the forced hot water system of circulation; automatic thermostatic control and the improved methods of air conditioning, ventilation and drying.

Having now touched with some emphasis upon the "determining factor" (the relation of heat to power)

in the economy of industrial power supply, the matter of next importance is the boiler plant.

Economy is the product of two elements—design and operation. The final efficiency is equal to the efficiency of the equipment multiplied by the efficiency of the management; or the efficiency of the machine times the efficiency of the brain; the machine multiplied by the man behind it. This means that you can, without redesigning your old plant, very considerably improve its efficiency and economy, unless your plant happens to be one out of a thousand, which a thousand to one it is not. This is the principle upon which the Fuel Engineering Section of the U. S. Fuel Administration was based during the war, and it resulted in saving 25,000,000 tons of coal annually by improvement of operation without change of equipment. This saving would have been doubled if there had been time to perfect the organization and fully extend the work.

Use of "What Instruments"

The first step is to make sure you are getting the best possible results from the equipment you already have. You should have the means of knowing every day the results you are getting. The essential figure you need to know is equivalent evaporation per pound of coal. The obtaining of this information involves the continuous measurement of weight of feed water or steam, weight of coal and feed water temperature and steam pressure. These together with occasional B.t.u. determinations of the coal used, will enable you to know the efficiency of your plant and how it compares with standard efficiencies for your kind of coal and equipment. These instruments tell what results you are getting, and may be termed the "what instruments."

Use of "Why Instruments"

Then when you find your results are too low, you will want to know why, so that you will be enabled to correct the preventable waste discovered. The determination of the causes of the waste is made by another class of instruments, which should be known as the "why instruments." In this class belong flue gas analysis apparatus and flue pyrometers which will check the one greatest loss in most boiler plants—the "dry gas chimney loss"—and the pyrometer will also indicate losses due to short-circuiting of gases and leaky baffles. Draft gages are also "why instruments." It will pay good dividends to apply a plastic airtight coating to the outside surface of all brick set boilers to stop air leakage, and be sure that all clean-cut doors and their frames receive due attention as well as header and other connections where air leaks are likely to occur. I have found in a "good" plant as much air leaking through the settings as was passing through the grates.

How Measuring Instruments Pay

Good judgment is required in selection of boiler plant instruments so that reliable records may be obtained. The records must be reduced to utmost simplicity without omitting essentials. The instruments must be chosen with regard to size of plant and human equipment, so that they will not cause an undue burden on the operating staff.

In one small plant where I recommended a very simple form of coal and water records alone, the evaporation was increased from 6 to 9 lb. per pound of coal and the equipment was paid for in about two months by the saving in fuel.

In another plant where the coal and water were already under measurement, continuous CO_2 recorders ("why instruments") were installed and resulted in additional savings which paid for the investment in three months. These instruments were used in conjunction with a simple bonus system for the firemen and shared by the engineer whose duty it was to keep the recorders in perfect order.

In the average factory plant very large savings can be made simply by operating the boiler plant on a production basis on the same principles which are always applied to the other departments of the business. The investment possibilities of so doing are very great, so great that it can be laid down as a definite, inflexible rule that every boiler plant should be placed under a suitable system of continuous records and observation. Ten per cent of the fuel consumption is a very conservative estimate of the resulting economy which follows such a plan when intelligently applied. This statement is based on experience in many plants of great variety. A simple change in the method of handling the fires often results in saving thousands of dollars a year in fuel. The need for such a change would not be discovered unless the "what measurements" and the "why instruments" showed the corrections to be applied. A quarter of your coal bill may be wasted or saved merely by the method of operating employed, without regard to the design of your plant.

Rules for Fuel Economy Operation

A few simple rules for fuel economy operation follow:

1. Maintain your equipment in first-class condition.
2. Keep the boilers clean, inside and out. This means free from scale and sediment inside and free from soot and dust outside the heating surface.
3. Keep soot from obstructing draft passages in breeching and chimney.
4. Employ instruments to know what results you are getting and why. Multiply these records and observations by your brains. In other words, make use of them.
5. Buy some brains and training, as well as brawn for your fire room. They cost more and they are worth more. They always pay good dividends. If I were allowed but a single recommendation, that one would be my choice. If you follow it, you will rejoice in good combustion with the savings consequent thereto, and many other economical blessings.
6. All surfaces wasting heat by radiation, such as steam piping, steam drums, feed-water heaters and other equipment, should be kept properly covered with high-grade insulating material. In one small plant $3,000 per year could be saved in this way. Insulation always pays good dividends.
7. See that the feed-water is heated by exhaust steam. There is 1 per cent economy in every 10 to 11 degrees rise in the temperature of the feed-water when so heated.
8. Steam-consuming apparatus must, of course, be kept in prime order, but of course it is not always done. Thousands of tons of fuel are wasted through leaky and badly set engine and pump valves, to say nothing of leaky pistons and rings; then there are also leaks in steam piping and waste through badly operating steam traps and high-pressure drips. These things are so simple that one hesitates to record them, but the waste of fuel through these simple and foolish channels is so great that a good operating engineer can frequently make a reputation by correcting them. Be sure you have a good operating engineer and don't skimp on his salary. He will earn it many times over.

Actual Examples of Large Dividends

I shall leave the rest of this story with him and shall now proceed to a story or two of what is accomplished when good operating and good designing are joined to-

gether as one. Although these stories are from my own experience, they can be duplicated from the note book of many a contemporary.

First there was the case of a steel company where $50,000 investment in better stokers, automatic coal scales and a little system of records returned $60,000 per year in fuel savings, or 120 per cent interest on the "securities" purchased.

One of the largest rubber companies in which furnace improvements, new chimneys, a boiler water softener and plant recording instruments with a system produced a saving of $850,000 a year for an investment of $683,000, or an interest return of 124 per cent.

In a woolen mill, a small one, where the heating had been done by direct steam from the boilers and the power supply was partly from its own compound condensing engine and partly from purchased current, a saving of $8,000 per year in the cost of current was made with an investment of $5,000, or a return of 160 per cent. This was accomplished by placing a non-condensing unit between the boilers and the heating system to supply the latter with exhaust steam in place of direct steam and deriving from this engine-unit by-product power to replace the purchased power.

In a large wire mill a large saving was made by purchasing power at a low rate instead of extending and improving the power plant. The saving was chiefly due to the fact that the owner was able in this case to get a quicker return on capital invested in the expansion of his production facilities than could be obtained by investing in power plant extension.

Large Dividends From Improved Methods

In another plant it was found by the preliminary study and investigation that an economy of $40,000 could be made in fuel and operating expenses by spending $148,000 on the remodelling of the existing plant which included provision for doubling the power output and for additional steam capacity. This work included a change in the kind of coal to one giving a greater quantity of heat per dollar delivered, the installation of suitable automatic stokers, labor-reducing coal-handling equipment, overhead feeder bunkers, automatic individual coal scales and feed-water measurement; the installation of an extraction type steam turbine unit to handle the power and heating demand in the most efficient manner, and improvements in electric power and distribution. The turbine was designed not only as an extraction machine but also to receive and convert into electrical energy any surplus exhaust steam available in the summer months.

In another plant manufacturing a variety of standard articles an opportunity was found to produce an operating saving of $260,000 annually by the expenditure of $250,000. A large factor of this economy was the fullest application of exhaust steam to building and process heating, thus reducing the combined cost of heat and power to a minimum.

It must of course be realized that it is impossible to treat with any pretense of thoroughness so great a subject as the Elimination of Waste in Industrial Power Plants in the very limited space here afforded. It is hoped, however, that the few suggestions I have attempted to indicate will assist to some extent in stimulating the kind of productive thought that precedes action.

New York, N. Y.

Estimated Savings With Superpower Central Stations

At the meeting of the Worcester Section of the American Institute of Electrical Engineers, Feb. 2, 1921, Henry Flood, engineer-secretary of the Superpower Survey, in speaking about What Superpower Means to the North Atlantic Seaboard, quoted a few figures which may best cover the potentiality of superpower central stations.

Nearly 40 per cent of the total value of manufactured products in the United States come from the north Atlantic seaboard region, and 35 per cent of the country's power is generated there.

This industrial supremacy can easily be visualized from the fact that one out of every eight persons living therein is an industrial worker, while for the remainder of the country there is only one out of every twenty-five persons so employed. New England is even more intensely developed from the industrial viewpoint, as one out of every 6.4 persons is a wage earner in its factories.

As great as are the power requirements of the region today, they are small compared with those of tomorrow.

The unassociated total power requirements have increased from about 15,000,000,000 kw.-hr. in 1910 to about 27,000,000,000 kw.-hr. in 1920, with a corresponding increase in machine capacity from 8,600,000 kw. to approximately 14,800,000 kw.

Estimated Growth of Energy Requirements

It is estimated that the power growth for the next decade will increase the total energy requirement to about 50,000,000,000 kw.-hr., and assuming the superpower to be in operation, about 18,700,000 kw. of machine capacity will be required to satisfy this load increase.

Electric public utilities furnished in 1920 about 12,000,000,000 kw.-hr. with a machine capacity of 4,000,000 kw., and it is predicted that by superpower operation the power to be furnished from central supply sources will grow to about 36,000,000,000 kw.-hr. by 1930 and will require a machine capacity in the neighborhood of 9,000,000 kw.

These estimates, which are conservative, call for 5,000,000 kw. additional power-plant capacity in the central supply systems during the next ten years, an increase of 125 per cent over the power plant capacity now in existence.

In the manufacturing industry the estimated power requirement of 1920 has been placed at 12,400,000,000 kw.-hr., and it is estimated that the central-station systems supplied about 2,750,000,000 kw.-hr. of this total requirement. By 1930 it is conservatively estimated that the total power load of manufacturing industry will increase to about 19,000,000,000 kw.-hr. and that superpower can economically furnish at least 10,000,000,000 kw.-hr., or slightly over 50 per cent of the total.

Had superpower been in operation in 1920 a saving of about 30,000,000 tons of coal having a value of about $162,000,000 could have been effected through its economies over the present performance of central stations, steam locomotives and isolated manufacturing plants, and by 1930 the superpower system should effect a saving of 53,000,000 tons per annum, with a value of $286,200,000 when compared with present practice.

The Patent Situation

Inadequate Salaries and Insufficient Personnel Are the Causes of Waste in the Patent Office for Which Industry Must Pay in Costly Delays and Burdensome Litigation—Analysis of Legislation Designed to Remedy the Situation

BY EDWIN J. PRINDLE

Chairman Patent Committee of the American Chemical Society

OUR patent system is of the first importance to the industrial prosperity of our country; but, until comparatively recently, it has worked so steadily and unobtrusively that the American public has come to be almost as unconscious of it as of the force of gravitation. The interruption of the patent system would be almost as disastrous to our successful competition with the rest of the world in manufacturing, agriculture and inventing as would be that of the law of gravitation to our physical lives.

The public has been apt unconsciously to think that inventions would be produced at the same rate whether or not there were a patent system and that our patent law simply imposed an unnecessary taxation, not realizing that if it were not for the inducements held out by the patent law the articles whose prices are objected to would not be produced at all.

SALARIES ARE UNATTRACTIVE TO QUALIFIED EXAMINERS

This attitude on the part of the public has so far affected Congress that, although the Patent Office is the only self-supporting bureau under the Government, its examiners are not even paid as well as scientific and legal employees in other bureaus which are not self-supporting. For instance, the salaries of the primary examiners of the Patent Office were fixed in 1848 at $2,500 per annum, which was one-half of the salary of the Chief Justice of the United States and was substantially equal to the salaries then paid United States District Judges and members of the House of Representatives.

In the seventy years since that date the examiners' salaries have been raised but 10 per cent, while the other salaries mentioned have been raised 300 per cent and more.

As the practice of patent law outside of the Patent Office is a profitable profession, the Patent Office became very largely a training school for patent lawyers, who left it as soon as they felt properly equipped for outside work.

There has been a class of examiners who would prefer life in the Patent Office, with its dignity and security, if the salaries were anywhere near adequate, even though the salaries and profits in the practice of patent law outside of the Patent Office would be much larger. The gradual rise in the cost of living being greatly increased by the war, it became not only impossible for many examiners to exist upon the salaries paid in the Patent Office, so that they have been resigning at the rate of 25 per cent of the total force per annum, but it also made the Patent Office positions so unattractive that it has been impossible to induce sufficient men who have the proper educational qualifications to take the examinations to fill the positions. It has therefore been necessary to appoint unqualified persons as examiners, and there is now a considerable percentage of unqualified persons filling those positions. More than 10 per cent of those now performing the duties of examiners in the Patent Office have not been able to pass the qualifying examination.

EXAMINER'S DUTIES ARE OF UNUSUAL IMPORTANCE

The war has taught the nations involved in it to be efficient as they have never been before, and a number of them have been improving and strengthening their patent systems. Our patent system has shown by its wonderfully successful operation that in its fundamental principles it is the best patent system in the world, but it did not begin to be so supremely successful until we adopted the principle of granting patents not only exclusively to those who were the original and first inventors of the inventions in question, but also only for those inventions which were not known to the American public nor, broadly speaking, accessible to them through the patents or publications of other countries.

It is chiefly for the determination of these two questions that the Patent Office exists. That determination requires that the examiners shall be thoroughly versed in patent law, and they should also be well versed in law in general. It also requires that the examiners should have a deep historical, theoretical and practical knowledge of the classes of inventions under their jurisdiction. They should be able to comprehend and analyze the fundamental principles underlying an invention. They should also be capable of seeing whether similarities or differences between previously known or rival inventions are matters of substance or only matters of form, and of distinguishing between differences which, although comparatively slight, are yet of substantial commercial and inventive importance and those differences which, on paper, may seem to be considerable, but really are unworthy of a patent.

They must either know or be capable of finding out and understanding the law which is applicable to the particular state of facts before them, or, as is occasionally the case, they must make new law by applying the basic principles to a state of facts which has no parallel in the recorded decisions. Examiners often pass upon inventions which are of very large importance to their inventors and of much greater importance to the public, and such large interests should only be intrusted to the best qualified men who can possibly be obtained by any reasonable salaries.

PATENTS SHOULD BE GRANTED WITH REASONABLE PROMPTNESS

The situation of the Patent Office has become desperate. The volume of work has increased very rapidly year by year for a considerable time, and the field of search necessary to be covered to determine the ques-

tion of validity has become broader and broader. However, the number of examiners has been increased only to a proportionately slight extent, the examining corps, as a whole, all the while having been weakened by the changes in it before mentioned. The result is that the Patent Office has become more and more unable to keep the quality of its work up to its former high standard, and it has also fallen farther and farther behind in turning out its work. In many cases unless a patent is granted with reasonable promptness, it might as well never have been granted, so far as the inventor is concerned, for the opportunity of disposing of it or of putting the invention on the market will have passed.

Invalid Patents Are Losses to Government and Industry

Moreover, the effort to keep from being submerged by the constantly rising flood of work has made it more difficult for examiners to make their searches thorough enough to determine whether the inventions are novel or not. The result is that patents which are partly or wholly invalid are being granted with increasing frequency. This is a very serious matter. An invalid patent means loss to the inventor and others who invest under it, and it may mean a very burdensome expense in litigation to one accused of infringing it and to the Government through taking up the time of the courts. These avoidable delays and defects in the Patent Office work tend strongly to discourage the production of inventions, and if they are allowed to continue and increase, the Patent Office will practically cease to function. Without considering the loss to individuals, which is serious, the loss to the American public would be incalculable if the Patent Office is permitted to become further impaired.

While it is not generally realized, it is nevertheless a fact that there is no one activity of our Government which is more important than the maintenance of the patent system. It has made us the most inventive of nations and enabled us to maintain the foremost position in manufacture and agriculture. Our unusual inventiveness is due almost wholly to our patent system; for Americans, being Europeans by extraction or immigration, are no more inventive naturally than the people of the nations with which we compete.

Lampert Patent Office Bill

In an effort to remedy this situation, the National Research Council appointed a committee at the request of the Patent Office, which, after investigation, formulated and obtained the introduction into Congress of a bill very moderately increasing the salaries and numbers of examiners and the clerical force of the Patent Office. The salary which the bill proposed for a primary examiner was but $3,900 per year.

This bill received the support of the American Chemical Society, the Federated American Engineering Societies, the National Association of Manufacturers and many other organizations. In fact, the scientific, engineering and manufacturing societies and interests of the country were practically a unit in favor of the bill.

The bill passed the House of Representatives and would have passed the Senate but for the fact that an unrelated section, known as the Federal Trade Commission section, was introduced into the bill by amendment in the Senate, and opposition to that section prevented the passage of the bill. In the present Congress, the bill has been re-introduced as the Lampert Patent Office bill, H.R. 7077. A favorable report upon it was unanimously voted by the Patent Committee of the House of Representatives, and the bill would apparently pass the House if it could be brought to a vote. The policy of retrenchment is understood to be preventing such action, the Government not realizing that the net effect of the Patent Office bill not only will not increase the expenses of the Government, but, on the contrary, will increase the income of the Government. Not only will the increases in salaries provided by the bill be paid out of the increased fees which the bill provides shall be charged for patents, but restoring the Patent Office to normal and efficient operation will result in the production of wealth in the form of inventions that will provide incomes affording taxes that will substantially increase the income of the Government.

Nolan Treaty Patent Bill

The Nolan treaty patent bill was passed in February, 1921, in response to an emergency resulting from the war. Under existing treaty provisions and our law, an inventor is given one year, after filing an application for patent in his own country, within which to file applications in treaty countries, with the same legal effect as to priority over other inventors as if his applications had all been filed simultaneously. In case of a contest with another inventor in one of the countries foreign to the applicant, the inventor is given the same benefit of priority as he would have had if all the applications for the patent had been filed simultaneously.

During the war many inventors in the countries foreign to the United States were unable to take advantage of such treaty provisions, and many American inventors failed to file applications for patents abroad, because they were in war service or because they did not know whether the outcome of the war would make foreign patents worthless and they likewise failed to pay annual taxes on their patents. The European countries extended the time within which applications could be filed or fees paid and our Government passed the Nolan treaty patent bill in order to reciprocate. If such bill had not been passed, the European countries would have invalidated applications for patents and payment of fees which they had accepted from American inventors in the expectation that such a bill would be passed here.

The bill protects American inventors and manufacturers to the extent that it reserves a license under any patents granted or validated by reason of such act to any American citizen who, before the passage of the bill, was *bona fide* in possession of any rights in patents or applications for patents which might conflict with any of the patents applied for by aliens, and the bill also preserves to any citizen of the United States, his agent or successor in business the right to continue any manufacture, use or sale commenced before the passage of such act by such citizens, even though such manufacture, use or sale might infringe a patent granted or validated by the said bill.

Stanley Compulsory Working and License Bill

The Secretary of War found that a considerable number of war inventions made in this country were being patented by others than their real inventors and the patents assigned to the Krupps in Germany. He therefore caused the Stanley bill to be introduced in Con-

gress to prevent aliens from patenting inventions here and then using those patents to enjoin the manufacture of the inventions in this country. The preventive measure is a condition to be inserted in the grant of all patents to aliens to the effect that any patents issued to persons who are not citizens of the United States shall be worked in this country within two years from the date of issue under penalty of having licenses granted under them by our Government to others who wish to work them in this country.

I believe that the bill is of doubtful efficacy to accomplish its purpose and is extremely unwise when considered in all its reactions. If an invention—and particularly a chemical one—were important enough for the Germans to want to prevent manufacture in this country, it would be worth their while themselves to manufacture here sufficiently to prevent the granting of licenses. This would tend to bring about the German manufacture here which we tried so hard to eradicate during the war, under the name of "peaceful penetration." If the invention were not one of sufficient value to make it worth while for the Germans to manufacture here, it would probably be one concerning which Americans would be indifferent as to whether it was manufactured or not. If the bill really hurt the Germans, then it would tend to induce them to keep secret all inventions which could be kept secret, and not to patent them. This course would deprive the American public of the knowledge of the inventions which they would derive from patents therefor and which they would be free to put in practice when the patents had expired.

Objections to the Stanley Bill

The Stanley bill would be in contravention to the Geneva International Convention, to which the United States is a party, as this convention provides that each country shall grant to the nationals of the other countries which are parties to it the same rights and privileges as they do to their own.

The enactment of the Stanley bill would undoubtedly result in the enactment of similar provisions in most or all of those countries which do not now require that American-owned patents shall be worked, so that Americans would be required to work most of their foreign patents. As there are many more American-owned foreign patents than foreign-owned American patents, the net result would be a disadvantage to our country.

In and out of Congress there is some sentiment in favor of applying a compulsory working requirement under penalty of having licenses granted to all United States patents without distinction as to whether they are granted to American or other inventors. If the Stanley bill were enacted in its present form, there is danger that it would be used as an entering wedge for such a general working requirement, and it is even possible that the present bill would be expanded for that purpose. I believe that such an amendment to our patent laws would be a catastrophe.

The test of the advisability of enacting the Stanley bill or any bill should be whether it will tend to increase or discourage the production of inventions, and if the advantage is not clearly in favor of such a bill it should not be enacted. It is dangerous to try experiments, for the common inventive faculty having been slowly developed through generations, it would take many years to restore it after it had become atrophied through disuse.

The following are some of the objections to a compulsory working requirement:

Many an invention which well fulfills its particular object is "ahead of its time" and is of no commercial value until the art and the commercial conditions with which it must co-act have grown up to it. This frequently does not take place until the later years of the patent, and of course may require many years longer than the monopoly of the patent. The cost of working an invention is almost always considerable—frequently very large—and if it were required that each patent should be worked within two years after issue, the working of such an invention would often be a total loss. Frequently the patentee would not be able to work it and would permit the patent to lose its salability, for a patent cannot usually be sold unless the complete monopoly, without any outstanding licenses, can be transferred. If, during the later years of the monopoly, it should appear that the patent would have been valuable if it had been worked, the inventor would be embittered by his needless loss, and many of those who would know of his experience would be deterred from inventing.

Any development to produce an invention goes through a course of evolution. Processes of manufacture and apparatus or machinery for that purpose frequently have to be invented. Auxiliary inventions often have to be made. Thus there is usually a group of patents that are necessary to protect the development and to prevent others from discovering and patenting some of the inventions in the group. Such a development frequently takes a number of years to reach a conclusion, and until that time it cannot be told whether there will be anything of sufficient value to be worth while putting on the market. Still, under the Stanley bill, it would be necessary to work each of these patents, which is in effect a fragment, within two years after its issuance, under penalty of having licenses granted to some competitor.

Discriminates Against the Poor Inventor

The Stanley bill discriminates between the rich and the poor inventor. The poor inventor would usually not be able to work his patent. Our patent system has been the door of opportunity, through which many men in the United States have risen from poverty to wealth. In so far as applying for and obtaining patents, in which there were no interference contests, and retaining the monopoly of those patents unimpaired, our patent system has heretofore treated all men alike. It should continue to do so.

The cost of working patents would greatly decrease their salability, for many corporations even would not buy a patent with such an expenditure attached as a certainty, and the purchaser would always pay much less for a patent carrying such a condition.

Many inventions which are patented under our system are of relatively small ingenuity, and often of no commercial value to their inventors, and yet, taken together in a single art, they occasionally lead the way to a point of view from which someone sees an opportunity to make a really important invention. These small inventions would not be made or patented if there were a general compulsory working requirement in effect in this country.

The compulsory working requirement in this and in other countries has not proved of substantial benefit.

New York City.

The Elimination of Waste in Marketing

Marketing From the Point of View of the Manufacturer Can Be Made More Profitable by the Application of Better Methods of Distribution and by the Establishment of Improved Selling Policies

By WILLIAM R. BASSET
Miller, Franklin, Basset & Co., New York

WE ARE frequently told of commodities which double and treble in price between the producer and the consumer, the blame being laid on faulty methods of distribution. Careful thought is not commonly an activity of the publicity-seeking fault-finder nor of his eager readers, therefore it does not occur to most that the profits of a long string of middlemen and handlers cannot be tacked onto the ultimate price unless consumers want the product badly enough to pay the price. The buyer makes the price ultimately —not the seller. In normal times—which comprise about ninety years out of each century—the buyer will not pay the charges of middlemen unless those charges represent a service which the customer values more highly than the money it costs him. Ask any of the financially dead or dying middlemen who sprang up in nearly all trades between 1915 and 1920 if this is not so.

As a consumer, I of course acclaim any reform which reduces prices, but in my professional capacity I am more interested in seeing the profits of producers increase. And that is not incompatible with constantly reduced prices to buyers.

I shall therefore in this article discuss faulty marketing from the point of view of the manufacturer, to whom such wastes represent unnecessary deductions from his profits.

Right off, it occurs to us that manufacturers may be classified as those who do not do their own marketing and those who have some degree of control over their marketing.

Industries in Which Middlemen Flourish

The manufacturers who do not do their own marketing are generally those whose product is more or less staple, who sell an un-trademarked, unadvertised product in bulk through factors, brokers, wholesalers, speculators, or anyone with the price. It is in industries of this sort that middlemen flourish, for it is they who presumably furnish the knowledge of the consuming markets which the manufacturers lack.

Frankly, I have never been able to understand the mental process of a manufacturer who, while retaining but a narrow margin of profit himself, will trust his marketing—even his very existence—to the mercy of middlemen who have no object in safeguarding his affairs. The usual explanation which such men make is that they are skilled manufacturers but are not salesmen; that they prefer to leave the selling to others more skilled in it; that a selling organization is a nuisance and an expense; and that by dealing with a few large distributers they avoid the effort and risk of handling multitudinous small accounts; that, being relieved of all these details, they can give their entire attention to producing, at which they are skilled, and, by improved processes, make more money than they would gain by improved marketing. The trouble is that, failing an individuality and reputation both for their business and for their product, they must compete practically on price alone, which keeps their margin of profit down, no matter how much they improve their methods. Their attitude suggests that they are, in fact, too lazy to study and master marketing technique.

However, every year a few of these old-established concerns reform and take over their marketing, and I believe that within a few years most of them will have joined the procession or have dropped out.

Ignorance of selling on the part of the members of the firm is not a valid excuse, for they can, if they wish, have their marketing problems solved by any one of dozens of advertising agencies which are highly skilled and which will outline every step in marketing in accordance with the peculiar needs of their client.

Manufacturers who exercise some degree of control over their marketing range all the way from those who sell directly to the consumer to those who sell through wholesalers. But they have in common the realization that to be permanently successful they must have a business personality. They know more or less accurately who buys their goods and why, and they know that control of their marketing, while it entails effort and expense, returns more than enough profit to offset it. But the wastes in marketing of concerns like this cannot be solved with a gesture, for they are complex and hidden.

Control of Marketing by Cost Accounting

The control of marketing is seldom based on an accurate knowledge of those facts which would unerringly point out where profits lie. I concur in the statement made by a well-informed commercial banker that "best sellers" in a line are properly objects of suspicion. Too often they are easy to sell, not because of their merit, but because they are unwittingly sold at a loss.

I know of a concern which manufactured fourteen products. Three-quarters of the business was done on three of the items. Low profits on the gross sales led this concern to install modern cost methods by which profit and loss was developed by lines. Seven of the items, including the three best sellers, each netted a loss; three which were only moderately popular with the management and customers showed a slight profit, and the four items which nobody in the concern loved made up the losses of their ten brothers and returned the slight net profit which the concern made as a whole. With these definite facts in hand, the management discontinued five of the lines, raised the prices on two, declined to sell three unless in assortments with more profitable items, and pushed the sales of the profitable ones. On total gross sales only half as great as before the net profit was increased 450 per cent. And this in a competitive market where war inflation was not a factor.

One cannot rigidly classify any phase of business and say, "This is a marketing problem," or "This has to do with production alone," or "Leave this to the bankers; it is in the realm of finance." Business is not so simple as that. Often the method of attacking a problem as a simple thing without ramifications results in policies damaging to profits. In the instance just given, we found that wrong selling was caused by wrong cost accounting.

So, as a starter toward sound and economical marketing, I earnestly recommend correct accounting of the cost of manufacturing.

Inefficiencies Eliminated by Correct Cost Accounting

Correct cost accounting will not only show in which lines profits lie; it will often indicate manufacturing inefficiencies which, when removed, will leave a satisfactory profit.

I recall one little-known concern which, as a result of accurate cost finding, not only relegated its best seller to the ranks but promoted one of its unimportant products to the vacancy, with the result that the concern has become not only highly profitable but known throughout the world as the maker of the once little-thought-of product. This was a result of the cost system showing gross inefficiencies in the manufacture of the unimportant and little sold product. When the inefficiencies were corrected, it became possible to reduce the selling price so drastically that the product became purchasable by many people to whom it had previously been out of reach. At its lower price, it has become practically a universal necessity.

"Well bought is half sold" is an axiom in merchandising; "well made is half sold" is no less true in manufacturing. Low price for good quality is an argument that needs no high-priced salesman to get across.

Selling Policies Dictated by Cost Control

High selling costs caused by great difficulty in selling indicate either that effort is being wasted in attempting to sell a product unadapted to the market, for which no need is felt, or that poor manufacturing makes the selling price too high. In the first case the concern had best look around for a product that the public wants—if redesign will not fit it to the market. If the selling price makes the product difficult to sell, the manufacturing methods had best be studied in an attempt to reduce costs. Here a cost system will be of help in two ways: First, by showing just where inefficiencies exist. Second, if the cost methods are modern, they will indicate the extent to which costs will fall as a result of increased production. With this knowledge the manufacturer can set a selling price which may be actually lower than his present cost of production, but which he knows definitely will quickly sell so much of his product that with the increased production will come lowered costs and a satisfactory profit. This is of value not only in settling upon permanent selling policies but also for temporary use in stimulating sales in times of business depression.

Analysis of Selling Cost

Much of what I have said so far will to many thoughtful readers seem like emphasizing the obvious; that I have stressed the elementary principles of marketing. That is true, yet it is exactly in violations of first principles that many of the selling wastes occur. But I am going now to describe something not quite so obvious. It is a recent development in cost accounting, which has nothing to do with manufacturing but which dissects selling expenses and indicates plainly wrong policies and wastes which are strictly of a selling nature.

It is, I believe, nearly universal practice to state the selling cost for the business as a whole as a percentage of the total year's sales. That is, with gross sales of $2,000,000 and a selling expense of $300,000, to call the selling expense 15 per cent, which for the whole business it of course is. But it is also customary to assume that the same percentage applies for each sales district and for each individual deal. If 15 per cent selling expense leaves a profit of, say, 10 per cent, it is easy to figure that so long as the total selling expense remains at 15 per cent, all sales, all customers and all territories are profitable, and if for the entire business the selling expense jumps to 30 per cent, it is assumed that all sales are made at a loss. Now suppose that a warm old friend of the company strolls into the office some day and gives us his customary spring order for $10,000 worth of our product. Did it cost us $1,500 to make that sale? Or take a small finicky buyer at the end of a 125-mile branch line out in Nevada on whom our salesman spends an entire day six times a year and who total orders in that time amount to $500. Does it cost only $75 to have him for a customer? Do we make a profit on his business?

The first man is so profitable that he is bound to be the target of all of our competitors. Some day, if we don't watch out, a competitor will make it worth his while to transfer his patronage. The other customer is probably not profitable and unless he can be developed we would be better off without him. But the books of most concerns are littered with accounts like his. He furnishes one of the greatest wastes in industry, which springs from the unreasoning effort to get an increasing volume of sales.

Expense Accounting for Each Customer

The idea that increased volume of sales necessarily means increased profits is a natural deduction from the percentage method of figuring selling expense. But it actually costs more and more to "comb" a territory thoroughly.

I have seen concerns make a good profit so long as they confined themselves to skimming the cream from the market, and go broke when they went out to get all the business in sight. Of course, someone must sell the small fellows in the out-of-the-way towns; I don't condemn selling to them. But I insist that some manufacturers are organized to do it at a profit while others are not. The buyer who would be unprofitable to one might well be profitable to another.

The first step is to find out just what it normally costs to have a salesman make a call on a customer or prospect. This normal cost per call will likely be different for each business, perhaps for each territory. In territories where customers are thick and towns close together, it may be low; in the Western States it will undoubtedly be high.

I recommend that an expense account be opened for each customer. Here he is debited with all calls made upon him at the normal cost per call, which, let us say, is $10. He is also charged with any other expense such as advertising, or the freight on returned goods. He is credited with the net manufacturing profit on the goods

sold him. This gives us an accurate line on how profitable each customer is to us, and the cause for the loss if he is not. He may require an undue number of calls to straighten out kicks; he may buy principally those lines which carry a narrow profit; he may have the habit of rejecting shipments; for any one of a dozen reasons his trade may be unprofitable.

Since we know just why he is unprofitable we may be able to educate him into a profitable customer or he may be so hopeless that we would do better to drop him. Or there may be reasons of policy for retaining him, even though he is hopelessly unprofitable. In any event our actions are not based on a false idea of what it costs to sell.

Territorial Selling Cost Analysis

A report which is of value is the territorial analysis. In the upper part of this we gather all of the items of selling properly chargeable to the territory, which includes the direct items such as salesmen's salaries and expenses, branch office expense and those indirect charges made up of share of general sales expenses, share of advertising, share of clerical expense and so on. The shares are not based on the volume of business. The method of distribution of selling cost is different for nearly every business. Take the general sales expense, for instance. If the sales manager spends most of his effort supervising salesmen, the number of salesmen in a territory would be the fair measure of how much of his salary should be charged to each territory. If, however, the sales manager is occupied with the solution of sales problems, it is usually best to have him keep an approximate record of the time he devotes to the problems of each territory and to distribute the expense on that basis. A different method is used to determine the shares of clerical effort; and still another to determine how much of the advertising expense is chargeable to each territory. In this way, we build up the total selling expense by territories.

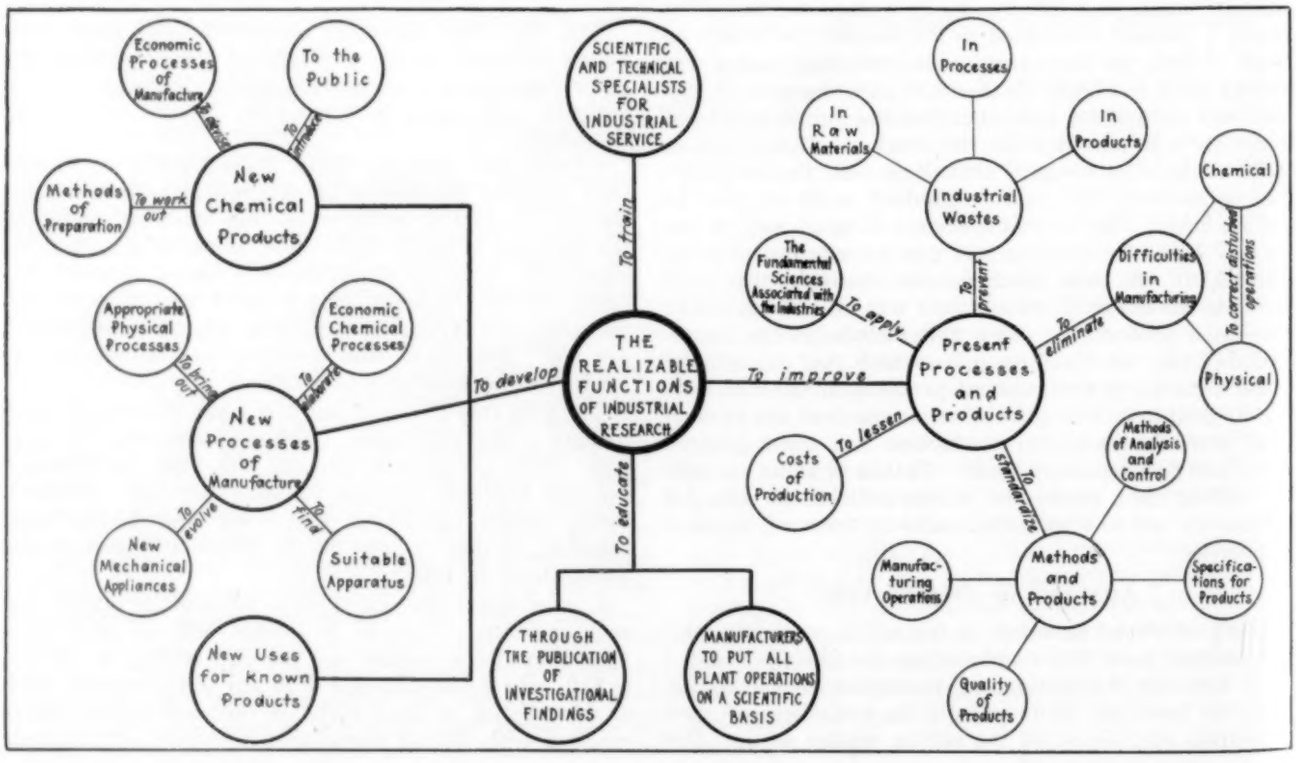
At the bottom of the sheet we note the number of calls made and extend it by the normal cost per call. Comparing this figure with the total actual expense shows whether the territory cost more or less than normal. If more, the cause may be either a reduced number of calls or extravagance on one or more items of expense. We divide the total calls made into those made on customers and those made on prospects. This gives us the amount of money spent in developing new business. We may even determine upon a proper proportion of the total expense which should be spent in development.

A supplementary report may well be used on which we list all customers and the net profit on each. From this we deduct the total by which the selling expense of all territories exceeds normal, and to it we add the amount by which all territories are below normal. This gives a figure from which is deducted the amount spent on sales development to give the net profit.

These reports properly devised to suit the needs of the individual business will analyze thoroughly the selling expense—show where the effort is good and where poor. The reports will not of themselves make profits; but they will give accurate data to the management on which they can build profit-making policies. They will help dispel the fog that has always hung over selling, and by indicating what the wastes are, will show how they may be eliminated.

New York City.

Hamor's Chart of the Aims of the Purposeful Study of the Problems of Chemical and Physical Technology



Wastes in Litigation

Losses Arising From Litigation a Potential Factor in the Success or Failure of Any Industry or Business —Lack of Knowledge of Technical Terms and Standards on the Part of the Courts a Strong Argument for the Establishment of Arbitration Courts Within the Industry

By WELLINGTON GUSTIN
Member of the Chicago Bar

THE average business man, upon going into business, at least in the past, has never figured on the probable losses that may arise from necessary litigation. This is a factor that cuts down profits, if it does not entirely destroy them, in nearly every business enterprise. Insurance against losses by litigation has not yet developed, though perhaps it is as certain a loss as that arising from credits, which are now being insured, or from other contingencies no more certain to happen.

But a very potential factor for harm and loss to any industry or business is possible litigation. It has put many a promising enterprise on the rocks. Anything from total disruption of business to a destruction of all expected profits on a contract may result from disputes ending in the courts. When men cannot agree the courts are necessary as a final arbiter, and it is not intended to lead any reader to take any statement herein as derogatory of the courts of justice. They are the bulwarks of our rights, our liberty and our civilization. But a broader intelligence will admit and encourage business men especially to take every reasonable step to prevent litigation. Here the ounce of prevention adage holds true, as almost any litigant will testify.

Chemical Industry Offers Wide Latitude for Litigation

In the chemical industry there is the widest possible latitude and opening from which claims and court actions may develop. In the manufacture and sale of chemicals and chemical products the specifications may be open to attack because lacking in certainty between the parties, because there may be no definite or known standard by which the parties may contract and to which they may refer to settle their disputes outside of court. An accepted authority, or standard known and accepted by the industry, would be a big step forward in the interests of the industry as well as the individual members composing it.

As the industry now stands a court, through its judge or jury, must pass upon the scientific and intricate questions of quality or other properties of chemicals, etc., which may happen to be in dispute between buyer or seller. And mayhap, to prove his case, a litigant will be required to bring in all the knowledge of the industry on the particular products in question as well as the customs and usages of the trade. Then all this will have to be done over again should a similar situation arise in litigation. This results in involved expense on every litigant.

There is another feature to be considered, and that is that after a case is litigated whether the correct results have been obtained and justice done; whether it would not be more satisfactory to the trade for men educated and trained and learned in the business to pass upon and decide questions of fact of which they have a peculiar and particular knowledge than to permit of these questions being decided by judges and juries unlearned in the particular field of science and fact being investigated.

Mutual Mistakes in Language of Contract

Sometimes a party to a contract contends that the language used and as interpreted by the other party does not express the "mutual" meaning of the parties. Whether it does or does not presents a serious question of fact that might be obviated or precluded by a recognized standard. The remedy of the complaining party is to go into a court of equity and have the contract corrected on the grounds of mistake of fact on the part of both parties. One can appreciate the difficulty encountered should the other party to such a contract deny there was a mutual mistake. In the ordinary case, the costs of such a proceeding and the obstacles to obtain proper evidence and make proof to show that language used in the contract did not express the mutual meaning of the parties are so great that justice is not had; and only when large amounts are involved and the litigants have sufficient resources to litigate and perhaps pay fees to scientific experts in the chemical industry may the true facts and a proper construction of certain agreements be arrived at.

Now when it is contended that the words of the contract do not express the mutual meaning of the parties, what may we, in the chemical industry, refer to as a standard? Have we anything definite and certain that will conclude these matters—prevent the use of the wrong words, or that will give such meaning and standard to the technical words of the science and industry, designating the standards of chemicals manufactured, sold and used commercially or otherwise, to prevent the claims that may arise out of the meaning of the contract in these respects?

Language of Contract Consirued by Court

Should an instrument of agreement contain language which, when it is sought to apply it to the subject matter of the contract, becomes ambiguous, a court is required, when the case is brought before it for a decision, to look to the facts and conduct of the parties, the surrounding circumstances bearing on the transaction, etc., to ascertain the sense in which it was mutually used. And the court's decision would rest on the facts shown to it that the language used could be given no other meaning than that contended for by the party who set up the claim of mistake in the contract.

If the language in an instrument, say an order or contract to manufacture and sell, is susceptible of more than one meaning, the parties are bound by the sense in which it was mutually used. But proving this point

presents, ordinarily, a legal issue, a fight in the courts. Recognized standards, accepted and approved in the chemical trades and industries, would in the main wipe out litigation of this kind. Certainty of this kind would first prevent any honest mistake in meaning of the parties at the time they enter into any arrangement, and it would prevent dishonest parties, for an advantage gained, later to set up a claim of mistake of meaning.

With regard to the meaning of words as used by parties in expressing their agreements, the popular or common standard controls on the face of things, but such is always open for proof to the contrary. Where a word or phrase is ambiguous, but was used and accepted by both parties to a contract in undertaking to express in writing the terms of the agreement actually made, they thereby have set up a mutual standard of their own and will be bound thereby. But such offers ground for litigation. The rule as to mutual standards in most states is subject to the modification that a clear and unambiguous meaning will not be overthrown by resort to oral or outside evidence to determine what the parties actually intended. (See Wigmore on Evidence, vol. 4, page 3475.)

Of the great mass of litigation clogging the courts throughout the country, only a small number comparatively reach the courts of appeal. Following are cases that have been brought up from the trial courts to appellate courts and often to the courts of last resort, where in some instances the litigation is finally and fully determined, while in others the cases are remanded and sent back to the original trial courts where the machinery of the courts is again set in motion—perhaps to be continued up by appeal or other proper procedure to the courts of last resort again.

The cases selected are those touching upon the quality, properties or specifications of the products, showing where a lack of standard makes it impossible not only to know in advance what is being bought and sold but prevents buyer and seller from referring to an accepted authority to settle their disputes.

Lack of Standards Causes Patent Litigation

Lack of standards enters into the inventive or patent litigation. An inventor describing his process and stating his claims names the chemicals employed, agents and factors used in producing a result. Others exploring along the same or similar lines are not informed by the patent with such precision as to steer them clear of the process patented. Employing chemicals as called for by the patent, they do not obtain the results claimed, and proceed in a search to improve the process or discover a true solution. In one noted case a learned scientist testified that he used the chemical factors called for by a process patent, but did not obtain the product of the inventor. He had used chemicals with certain impurities, according to the testimony of other scientists who had obtained the desired results with chemicals of a different standard. (Matheson vs. Campbell, 69 Fed., 597.)

This lack of proper standards for chemicals confused the users of the patent and there developed a useless competition and infringement. By making certain tests of the chemicals employed and using only those up to a certain necessary requirement or standard, the users of this process testified, they obtained the product of the patent. Those using the same chemicals in kind but of a different standard of purity were misled by the patent claims, and believed that they were untenable. Here the court held that the use of "nitrate" of sodium for "nitrite" of sodium in the specifications of a patent relating to the manufacture of a coloring compound from coal-tar products was not such a misuse of terms as would invalidate the patent; it appearing that no one skilled in the art would be misled thereby and that the use of "nitrate" for "nitrite" was common in the earlier patents relating to the particular art. Here, too, the court defined "chemically pure" to mean absolutely pure, and "technically pure" as used in reference to substances employed in chemical processes to mean pure in the ordinary acceptation of the terms of the art.

Right to Inspect Goods Before Acceptance

The case of the Imperial Products Co., Inc., vs. Capital Chemical Co. involved the question of inspection of the product sold (176 N. Y. S., 49). The buyer of the product demanded the right to inspect the goods upon delivery and before payment. In such a case with known standards and an agreement based thereon, the matter of delivery would ordinarily be of small moment, as an acceptance of delivery could not be shown to establish the quality of the product or be taken as an acknowledgment that it conformed to the specifications or other descriptions of the agreement.

The law involved in this case is to the effect that under the personal property statute of New York a buyer is entitled to inspection of goods purchased, before delivery and acceptance, unless there are terms to the contrary; that a carrier of the goods is bound to permit of this inspection unless the sales agreement is that shipment should be made "collect on delivery."

Under the New York law, where no terms of payment are specified delivery and payment are concurrent obligations, and the buyer has the right of inspection to ascertain whether the goods are in conformity with the contract, when the seller tenders delivery, before he is required to accept and pay for the goods. But the court says this is very different from payment of the purchase price by sight draft with bill of lading attached. Here payment is a condition precedent to delivery and hence inconsistent with the right of inspection.

Seller Liable When His Goods Ruin Products Manufactured by Them

In the case of James K. Thompson Co., Inc., vs. International Compositions Co., Inc. (181 N. Y. S., 637), the Thompson company brought suit to recover the purchase price of a quantity of copper oxide. The amount contracted to be sold was 11,862 lb., which at 33c. a lb. amounted to $3,914.66. There were three deliveries of this oxide. After the third delivery the defendant returned 2,907 lb. and the plaintiff, Thompson company, received it and gave defendant a credit therefor. The balance due for the oxide not returned and accepted was $2,955.15, and plaintiff recovered a judgment for this sum.

On appeal the Appellate Division of the New York Supreme Court reversed the judgment and granted a new trial. It appears that the copper oxide was sold for a specific purpose—for making a high-grade anti-fouling marine paint. It was admitted that the first two deliveries of the oxide were up to the standard required by the defendant. But there was evidence to show that the third delivery was not up to the standard required by the paint manufacturer and not in conformity with

requirements of the contract and with the standard of article known by the seller to be necessary for the buyer's uses. Before discovering the defect in this article, however, the buyer had used a part of the third shipment, and in making paints therefrom, it made paint which was utterly useless and which was returned by its patrons, and the buyer claimed to have suffered damages by reason of the loss of other materials that were used in the paints, which were then rendered unsalable by reason of this defective copper oxide. Therefore against the seller's total claim for oxide delivered the buyer set up a counterclaim for damages thus suffered in the amount of $5,267.66.

In defining the rules of law which govern the plaintiff's right to recover the court said that if the plaintiff had knowledge that the defendant required a certain quality of copper oxide for the use of the paint as it was manufactured, then it was bound to furnish that quality under the contract, and that the burden of proof was upon it to show that quality was furnished. On the counterclaim of defendant the court stated that the defendant had the burden of proof, in establishing its counterclaim, to prove that the goods were not of the quality required by the contract, and required by the knowledge that the seller had of the buyer's requirements and the damages that were suffered therefrom.

Advantage of Having Known Standards

In the case of E. I. du Pont de Nemours & Co. vs. Robinson & Son, 204 Ill. App., 529, an advantage of having known standards and quality is presented. Here it was held that although the buyer was given opportunity to examine the product delivered and although it was subsequently used by the buyer, such did not constitute an admission by the buyer that the quality of the product was satisfactory and that it conformed to the contract. For, under the facts in this case, a mere examination by the buyer of the boxes and their contents would not necessarily inform the buyer of the quality of the product, says the court. But where may the complaining party go for proof of what he bought? To his contract. But to what standard and what reference may each of them go in case of dispute as to contract, or better still, in drawing up the contract in regard thereto?

Buyer's Right to a Particular Brand Ordered

Of course no standards or other precautionary acts of parties entering into a contract may prevent frivolous defenses and claims being made where litigants are so disposed to fight. All that this forward step can do would be to reduce the difficulties to a minimum and make the results of a suit in equity or an action at law more certain, with the facts or evidence and the proper benefits available to the rightful party or parties.

Again, where one contracts for a particular brand of product he is legally entitled to the brand, though the standard is the same as another substituted. In the case of Coff-Garrod Co., Inc., vs. Dodwell & Co., Ltd., there was a contract for the sale of Monsanto or Heyden brand saccharin of a specified grade or standard. The product was sent in boxes of the American Condiments Co., a subsidiary company of Heyden Chemical Co. The evidence was that the parties were contracting for goods of a certain character and quality, and not labels, and that "Heyden brand" and "Heyden make" of saccharin meant the same thing. Therefore, since the complaining party obtained a product of the standard contracted for and of the proper manufacture he could not set up a defense of improper trademark or brand. (170 N. Y. S., 615.)

Sale by Description Cannot Be Transformed Into a Sale by Sample

In the case of American Aniline Products, Inc., vs. Mitsui & Co., Ltd., there were three sales contracts for dyes for export. The buyer claimed samples of dyes were submitted with the offer of sale, and it was agreed deliveries of dyes under orders would be equal in quality, strength and all other respects to the samples submitted. The orders showed a sale by description, being "Amacid Blue Black K N" and the court said the obligation of the seller was merely to deliver goods to that description of merchantable quality. To attempt to transform a sale by description into one by sample is to attempt to vary the obligation of the seller as to the quality of the article to be delivered, which could not be done. And the evidence as to the sample submitted prior to giving the written orders was not admitted in the case. However, the court held that upon trial either party would be at liberty to define by word of mouth the term "Amacid Blue Black K N." Such evidence does not vary the meaning of the writing, but discloses the full meaning of the parties. The Supreme Court of New York and the Appellate Division were called upon to decide these points.

Delivery of One Grade When Buyer Thought He Contracted for Higher Grade

In the case of the Independent Trading Co., Inc., vs. E. Fougera & Co., Inc. (183 N. Y. S., 431), plaintiff brought an action to recover damages for alleged breaches of written contracts for the sale of potassium guaiacol sulphonate, c.p., white. Defendant admitted the contracts but defended on the ground that it never understood that it was agreeing to deliver to the plaintiff the quality of the chemical called for in the contract and which plaintiff claims the defendant agreed to deliver. Upon trial the sole question presented was of a mutual mistake respecting the identity of the article in suit.

Upon this proposition it was claimed that there were two grades of potassium guaiacol sulphonate recognized by the trade. One of these grades was claimed to be in powder form, known as calcine, the other being a crystalline form of perfectly white crystals. The calcine was at time of the sale of the value of $10 per lb. and the crystalline form was of the value of about $30 per lb.

The seller understood that the article called for by the contract was the calcine or powdered form then being sold as the commercial product. This product was being manufactured by the Lister Chemical Co. It was not the same article called for in the contract. On the part of the seller it was shown that another product known as "thiocol" was on the market, which contained the same chemical ingredients as potassium guaiacol sulphonate. Thiocol, however, was a trade name belonging to its manufacturers, the Hoffman-LaRoche Co. And the testimony for the seller that it had sold the cheaper article, and that it was customary to use the term "thiocol" or the term "crystal white" in describing the crystalline form was not supported.

In its opinion the court says it is convinced that no mistake was made by either party; that the seller was endeavoring to sell to the trade an inferior product and

deliberately intended to deliver, under the contract, an article known to be inferior; and the seller, having made the contract in question which used the terms well understood in the trade, should be held to a strict performance thereof.

On the question of mutual mistake as to the identity of the product in suit, the court said even though the evidence supported the seller's claim that it did not understand the effect of the contracts which it made, and did not know that it thereby agreed to sell and deliver the crystalline form of the commodity, there was no mistake on the part of the purchaser. It knew what it wanted and what it bargained for—namely, "potassium guaiacol sulphonate, chemically pure, white." What this product was, as established by the trade, could not be denied by the seller.

A standard and knowledge in the trade as to the product in dispute dispensed with the more intricate questions that might have arisen had there been no standards for reference and proof. Putting over an inferior product, as the majority believed was attempted here, might become an easy matter with unscrupulous dealers.

Quality of Steel Question for Jury

In the case of Griffin et al. vs. Metal Product Co. (107 A., 713) defendant purchased from plaintiff certain high-speed steel. The buyer acknowledged receipt of the steel, that it appeared to be in good condition, but alleged that upon use it was valuable only as scrap steel. The question as to the quality of the product was presented to the jurors, who decided from the evidence that the steel was high-speed steel and gave judgment for the defendant buyer. But the Supreme Court of Pennsylvania has reversed this judgment and granted the defendant a new trial.

Under the uniform sales act providing that on sale of an article under its patent or other trade name there is no implied warranty as to its fitness for any particular purpose, a "trade name" is a name given by a manufacturer to the particular product made by him, and the generic name of an article made by several is not a trade name. The Supreme Court holds that speed-steel is not a trade name but a name common in the trade and where sold for use by the buyer for a use known to the seller there is an implied warranty of quality suitable for the purposes intended.

Kind of Goods Delivered a Question for Jury

In the case of Samuel and others vs. the Delaware River Steel Co. (107 A., 700) the Supreme Court of Pennsylvania said the kind of goods delivered under the sales contract was a question for the jury to determine from the evidence submitted. There was an appeal in this matter from the trial court to the Pennsylvania Superior Court, thence to the Supreme Court, where it was finally remitted to the Court of Common Pleas for a new trial.

It appears that the defendant purchased from the plaintiffs, brokers in steel and iron products, two carloads of a commodity known to the trade as "roll scale." Upon unloading the material the Steel company discovered, as it alleged, that the contents of one of the two cars contained largely mill cinder, a product of less value than roll scale. The buyer used the product in dispute, but refused to pay on the basis quoted for roll scale. The seller contended the product delivered was roll scale, and further, that if it were not such product, the buyer, by accepting and using the product, waived the right to object that it was not the article ordered.

Intention of Parties Determine—Where Ambiguous Words Are Against Party Using

In the case of Fletcher vs. Interstate Chemical Co., the question was the construction of the contract. (110 A., 709.) The Supreme Court of New Jersey here said the cardinal rule in the construction of all contracts, sales included, is that the court must, if possible, ascertain and give effect to the mutual intention of the parties, as far as that may be done without the violation of legal principles. And where a contract is ambiguous it will be construed most strongly against the party preparing it or employing the words concerning which doubt arises. This case was appealed from a judgment of the trial court to the Supreme Court, where judgment against defendant was affirmed.

Strict Reading of Contract Enforced

In the case of Filling Machine Co. vs. United Smelting & Aluminum Co. (107 A., 619) the sole question involved was whether "rod aluminum" meant pure aluminum. The jury in the case was instructed by the trial judge to determine whether the words in the order given "to be drawn to our specifications" had any distinct well-known meaning in the trade, applied to both size and composition or to size only, and whether plaintiff knew or ought to have known that the words were used in such special sense. On appeal this instruction to the jury was held error by the Supreme Court of Errors of Connecticut.

This court said the sale being of specific goods designated as "rod aluminum" in the written contract as completed and in the written negotiations leading up to the contract, it was the duty of the seller to furnish "rod aluminum" as that term was ordinarily used in the trade.

Goods Must Be Suitable for Uses Required

In the action by Smith, DeMacedo & Co., Inc., vs. Swift & Co. (110 Atlantic, 141) it appears that Swift & Co. sold the plaintiffs 34 tons of oleo-stearine which was represented to be suitable for the same purposes or uses and to comply with the specifications set forth for stearic acid. This product was to be resold and exported to Portugal for use there. Upon arrival there it was found that the article did not conform to specifications, the plaintiff's customer declined to accept the shipment, and it was necessary because of shipping conditions to sell the product in Lisbon at a loss to the best bidder.

Smith, DeMacedo & Co., Inc., brought suit to recover damages for failure to deliver goods answering the warranty that they would be suitable for the uses required. This case was carried to the Supreme Court of Pennsylvania and a judgment for the plaintiff was sustained.

Representations by Seller Amount to Warranty

In the case of Swift & Co. vs. Meekins et al. plaintiff sued to recover for the price of fertilizer and acid phosphate. Defendants set up a counterclaim for breach of warranty as to quality of the fertilizer. The sale consisted of 10 tons of acid phosphate and 40 tons of fertilizer analyzing 5-7-0. Meekins testified that

sellers' agent, at time of the sale, stated the fertilizer was as good as any of the same analysis sold to be used for cotton and corn and was as good as any on the market. The case was carried from the trial court to the Supreme Court of North Carolina when the court held these statements amounted to a warranty in law. The positive representation, without any intention to deceive, by a seller that the article sold possesses a certain value and certain qualities amounts to a warranty and the purchaser may set up the breach of warranty to reduce the sum claimed.

Goods Not Up to Specifications

In the case of Grasselli Chemical Co. vs. City Ice Co. (75 So., 920) action was brought to recover the price of certain shipments of anhydrous and aqua ammonia. Defendant claimed that plaintiff warranted all anhydrous ammonia perfectly pure and dry and all aqua ammonia sold to be absolutely 26 deg. aqua ammonia, which warranty was breached, causing a resulting damage to it of $7,500. The Chemical company contended that it sold all of the ammonia by description only; that the aqua ammonia was sold as 26 deg. at 60 deg. F., and was merchantable; that the anhydrous ammonia was merchantable dry anhydrous ammonia; and each was so warranted. It further charged that defendant's trouble in its use of the product was due to its machines and not to the chemicals employed. An adverse judgment was rendered against the Chemical company and it appealed to the Supreme Court of Alabama, where the judgment was affirmed.

Contract Providing for Settlement of Disputes

The case of Home Guano Co. vs. International Agricultural Corporation involves the sale of 21,600 tons of sulphuric acid. This case was decided by the Supreme Court of Alabama. (85 So., 713.) While there is no controversy over the quality, kind or properties of the goods sold, the contract covers these matters so well that it is given here. Contracts are usually loosely drawn, and never cause any difficulty as long as both parties are satisfied in their dealings, but when dissatisfaction crops up the terms and provisions of the contract become important. The contract provisions here given show how the parties provided for disputes as to the product sold:

"It is understood that seller is privileged to deliver acid of greater or lesser strength than 60 degree Bé., but not less than 57 degree Bé. nor more than 62.50 degree Bé. For any excess in such acid above or below 60 degree Bé. a proportionate reduction shall be made in the price per ton according to the per cent of 60 degree acid contained in such acid of higher or lower degree, as set forth in the table of the Manufacturing Chemists' Association. Approximately at the end of each month seller shall reimburse buyer for additional freight which buyer may have paid or incurred liability for by reason of the shipment of acid of weaker strength than 60 degree Bé., and buyer shall pay to the seller the amount of freight charges saved to the buyer by reason of the shipment of acid of greater strength than 60 degree Bé. Settlement shall be made for each and every shipment upon the basis of 60 degree Bé., as determined by the producing company, at Copperhill, Tenn., whose test shall be the basis of the settlement. In case of dispute as to the accuracy of such analysis, sample of the carload in question, as drawn by the producing company at Copperhill, shall be submitted to analytical chemists, Ledoux & Co., 99 John St. New York, for analysis, whose determination shall be final."

How Standards May Be Established

In Penn Steel Castings Co. vs. Wilmington Malleable Iron Co. (41 A., 236) wherever an order was to be carried out with quality "up to standard" it became necessary to prove the standard. In attempting to define the contract meaning of the term the court says a standard implies a measure or test which has the general concurrence and recognition of the class of persons engaged in the particular business or trade under consideration.

Now long and continued usage may develop and determine standards in any field. Considering how long-established and widely known has been the particular business involved in the steel industry, the court thought it was not unreasonable for it to presume, until the contrary be shown, that some well-known standard was generally recognized in that business or trade.

Thus standards may grow slowly through a mass and haze of difficulties with all the attending losses and lessons of experience, or they may proceed in an orderly march, being established in an exact and scientific manner, agreed upon in advance, recognized and approved by the trade.

All these transactions and matters are affected through the factor of evidence in controversies or disputes. When parties dispute the facts, dispute the quality or properties of the subject of contract agreement, where shall they go for aid? What is the mean or standard of measurement that may be brought in to determine the truth and facts in the evidence? What, itself, may be the evidence? With established standards the facts and truth as to matters in evidence may be readily arrived at in a manner satisfactory to all concerned, preventing at the same time dishonest transactions which are now possible.

Advantages of Arbitration Laws

Some states have enacted what is known as an arbitration law, notably New York and Illinois. These laws offer much promise to business men, but, being a new departure, have not been availed of to any great extent.

Where contracts contain the proper provisions for arbitration of the differences arising thereunder, in states having these laws it appears that the quality of products and other similar grounds of dispute may be more readily determined, the facts more properly found by referring to an arbitrator or a board of arbitrators—all skilled or educated in the field of inquiry.

I am of the opinion that many of the difficult questions arising in the chemical and allied industries can best be met by an acceptance of such new laws as offer the opportunity of arbitration in disputes and by making use of them. This last is a very necessary and vital thing—the making use of the principle. Skilled and experienced men should be designated as arbitrators, perhaps by the various industries in advance, to whom parties to a contract may look in case of disputes arising. Boards of arbitrators may, in the future, take the place of and do much of the work of courts, unlearned in the particular fields of inquiry. But arbitration will require no little effort for its firm establishment.

Chicago, Ill.

Eliminating Waste and Nuisance in Smoke, Fume and Gas

Suppression of Industrial Waste Byproducts Is Essential Not Only to Avoid Economic Loss but to Abate Nuisance in Residential Localities—Methods Originally Developed for Metallurgical Processes Find Application in a Wide Variety of Industries

By P. E. LANDOLT
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WITH the rapid growth of industry in the past twenty years, we have been confronted with the necessity of waste elimination for conservation or as a public necessity. Waste elimination is truly economic, benefiting industry directly in many cases and ultimately the public. A phase of the industrial waste and nuisance problem that has had a pronounced effect on the industries and the surrounding localities is that of so-called smoke nuisance. In some instances it was allowed to increase to a point where local damage was extreme, and later during its abatement many interferences and delays to industries resulted. Frequent abandonment of large industrial plants followed, and the economic losses, both public and private, were very great. Much of the smoke nuisance has been tolerated or ignored by the public, either accepted as inevitable or essential to industry. Moreover, it has been borne with sullen indifference or accepted as a commonplace like the weather, etc.

Solution in No One Method

The solution of these problems of smoke nuisance or air pollution cannot be effected by any one method, because our industries are essential to the progress of civilization, and therefore careful consideration must be given to every phase of any one problem to be certain that real improvement has been made. If other wastes as great in magnitude as the original one result, then nothing has been gained. All of these problems, therefore, require broad treatment by industrial specialists and by engineers, so that the benefits obtained may be of lasting value.

Prevention is a first consideration; but frequently it is found quite impossible, at least impractical, to prevent such loss or nuisance due to waste gases. Sometimes it is found desirable to carry off materials in waste gas currents and recover such materials later, separated from other materials with which they were originally associated. Moreover, after such materials are removed from a gas, it may be useful for other purposes where it would be useless if not free of such suspended matter.

Many schemes have been used for the removal of suspended matter from gases and under certain conditions have proved satisfactory. In general these consist of mechanical devices for settling dust by gravitation, centrifugal action, baffling or change in gas velocity; washing with water or other liquids, as a fine spray or over packed towers; filtering by means of cloth bags, screens or layers of finely divided or fibrous substances. All of these methods have fairly well-defined limitations, such as temperature, corrosion, power requirements, replacement costs; the quantity and composition, both physical and chemical, of the material to be removed; water consumption or disposal of the collected material.

Electrical Precipitation

The development of electrical science has added to the foregoing another method—namely, electrical precipitation—which has been developed commercially during the past fifteen years, and which has been shown to have a wide range of practical operation, particularly where corrosion and high temperature are factors or large-volume treatments are essential. The equipment required for the operation of the Cottrell electrical precipitation processes has been gradually standardized to make these processes readily adaptable to a wide range of industrial problems. The monetary value of metallurgical smoke recovery, for example, has been tremendous, but the resultant applications developed constantly increase the field of usefulness of these processes and promise even greater value in the future as an essential part of other new processes and industries.* The diversity of these applications is shown by the following summary:

I. Non-ferrous Metallurgical Fume and Dust: Recovery of copper, lead, tin, zinc, silver, gold, bismuth, etc. Operations: Sintering machines, reverberatory furnaces, blast furnaces, converters, roasters, driers, etc.

II. Acid Problems: *a.* Sulphuric acid—concentrators (new, spent and sludge acid), parting kettles. *b.* Nitric acid—nitrating operations. Phosphoric acid—phosphate rock reduction. Hydrochloric acid—roasting operations, pickling, etc. *c.* Miscellaneous—Recovery of chlorine, bromine, etc.

III. Smoke, Soot and Cinder: *a.* Boiler plant gases. *b.* Engine roundhouses. *c.* Lamp black from oil. Carbon black from natural gas.

IV. Cleaning of Gases Containing Sulphur Dioxide: *a.* Hot gas (pyrite burners)—sulphuric acid manufacture. *b.* Cold gas (pyrite burners)—sulphuric acid manufacture; (sulphur burners)—sulphite liquor production.

V. Combustible Gas Cleaning: *a.* Iron blast-furnace gas cleaning. *b.* Hot producer-gas cleaning. *c.* Tar recovery from producers, illuminating gas, coke ovens, low-temperature carbonization (fractionation), wood distillation.

VI. Air Cleaning: *a.* Small capacity installations—foundries, machine rooms, etc. *b.* Large volume installations—slate crushing, etc.

VII. Miscellaneous Applications: *a.* Dust and fume from industrial operations: 1. Potash from cement

*For the purpose of this presentation no direct reference will be made to the theory and description of these processes. For complete details of same the reader is referred to the selected bibliography at the end of this paper.

kilns. 2. Large electric furnaces. *b*. Dust and fume from miscellaneous chemical plant operations. *c*. Organic materials—spray drying, milk, fruit juices, etc.

In the Metallurgical Industries

The metallurgical industries have contributed most largely, if not entirely, to the commercial development of these processes. The early efforts of Sir Oliver Lodge in England, Dr. Moeller in Germany and Dr. F. G. Cottrell in the United States led to final accomplishment. Dr. Cottrell was greatly aided in his early work by the co-operation of local industries, primarily E. I. du Pont de Nemours & Co., at Pinole, Cal., and the Selby Smelting & Lead Co. at Vallejo Junction, San Francisco Bay.

Copper Industry.—Many large copper-smelting plants have been equipped with Cottrell precipitators, making recoveries of copper, silver, gold, zinc, lead, arsenic, etc., that have paid from 15 to 50 per cent net per annum on the installation investment after deducting all operating charges, depreciation, interest, repairs, etc. In addition all damage to the surrounding country has been eliminated or minimized. The total investment in Cottrell installations in copper smelters is approximately $5,000,000, and with a net return on investment of 20 per cent on such installations, this represents a net saving in copper alone of at least 5,000,000 lb. per annum, and a total of at least 8,000,000

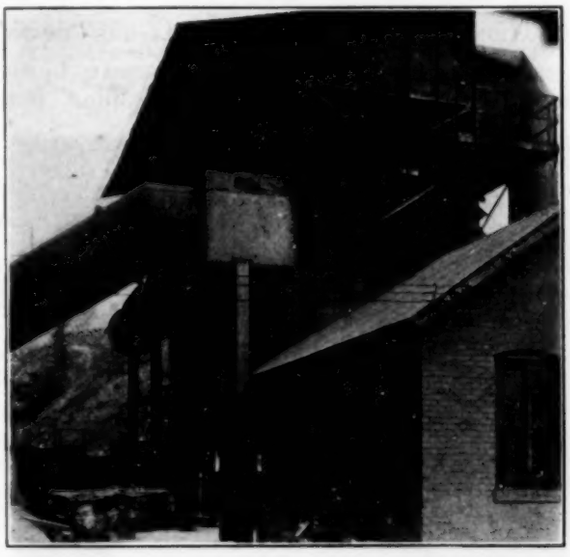

FIG. 1. ELECTRICAL PRECIPITATOR FOR RECOVERING LEAD, TIN AND ZINC FUMES FROM REVERBERATORY FURNACES HANDLING DROSSES

cu.ft. of gases have been so "treated" per minute (400,000 to 500,000 tons per twenty-four hours).

Lead Smelting.—Many lead-smelting plants have installed Cottrell precipitators, and the net recoveries compare favorably with those in the copper industry. At least $3,000,000 has been invested in these installations, with a corresponding net saving of at least 15,000,000 to 20,000,000 lb. of lead per annum.

Tin Smelting.—Numerous secondary metal plants and a primary tin smelter have been equipped with Cottrell precipitators and have paid a net return per annum on their investment of at least 50 per cent (in some cases nearly 100 per cent) after making all deductions, fixed charges or operating expenses. The total investment in these installations is nearly $400,000, and the consequent net saving is at least 2,000,000 lb. of tin per annum.

Silver Refining.—The large silver refineries (whether from copper- or lead-smelting sources) are equipped with Cottrell installations. The total investment in them is not over $300,000, but the total recoveries in silver alone are at least 500,000 oz. per annum. Considerable gold is also saved in addition.

In the Chemical Industries

The development of the chemical industries has given further opportunity for the application of these processes.

Sulphuric Acid.—Sulphuric acid mist is well recognized as difficult to catch by ordinary means. Dr. Cottrell first applied electrical precipitation to sulphuric acid mist and found the mist was "condensed" or precipitated electrically with the greatest ease.

During the war maximum operation of sulphuric acid-concentrating plants made the acid mist nuisance quite pronounced. Various scrubbing devices used were a failure, were impractical, or rendered this recoverable acid a complete loss. Cottrell installations for this purpose during the war period from 1917 to 1919 made an acid saving, besides abating a serious nuisance, of at least 10,000 tons (66 deg. Bé.) acid per annum. Further development of these processes at that time would have avoided far greater wastes.

Applied to the recovery of sludge acid from oil-refining operations in conjunction with approved sludge acid concentrators, more or less recently developed, these processes serve as a useful part of such equipment. The Cottrell precipitator collects practically all of the acid discharged with the waste gases, returning it to the system at an appreciable concentration. The total acid losses in such a combined system are reduced to a minimum. Acid problems usually mean property damage, and even where the plant is isolated the elimination of acid gases is justified for the saving of wear and tear on plant buildings, roofs, products, etc.

Phosphoric Acid.—These processes are being utilized in connection with the direct reduction of phosphate rock in electric or other furnaces. Phosphoric acid is recovered directly and is used to saturate phosphate rock, giving a superphosphate of high P_2O_5 content, saving the use of sulphuric acid and extra freight on the transport of acid or a phosphate product of less value per ton.

Elimination of Smoke and Soot in Power Plants

Smoke and soot from large power plants have been decreased in most cases to an almost negligible amount, but an ever-increasing problem of cinder and ash dust being carried out of the stacks is a serious one. The former problem is being solved largely by preventive methods (improved mechanical firing equipment, control of fuels, etc.), but the latter problem of cinder and ash appears to be soluble only by supplementary collection. Here the material collected is almost if not entirely valueless, the gas volumes are very large, and the duty is extremely severe. Such plants, being operated to their maximum ratings, require close draft adjustment and practically no draft interferences. Schemes have been tried and have succeeded to a large extent in improving stack conditions for such power plants. In the main, therefore, Cottrell installations have not been justified for such conditions, but the

development of apparatus for electrically cleaning such gases at very high velocities (2,000 to 3,000 linear feet per minute), together with the development of powdered fuel combustion for power plants, promises to create a real need for such equipment on a basis that will be sound economically.

The Nuisance of the Engine Roundhouse

The large engine roundhouses in cities present a problem that constitutes a real nuisance. Owing to the corrosive nature of the gases from such roundhouses, washing equipment is costly to install and maintain.

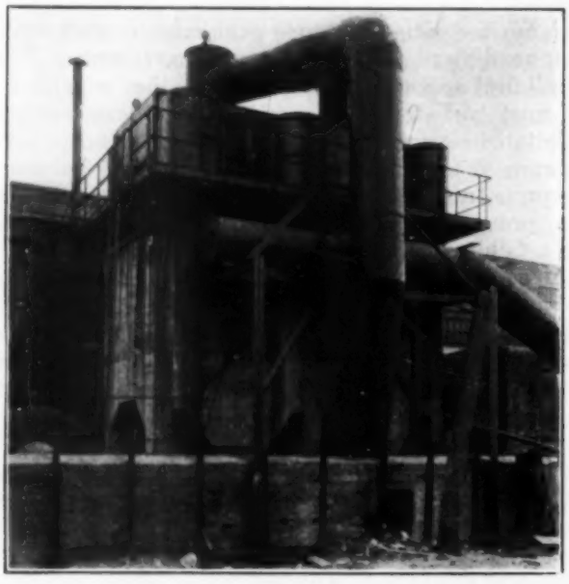

FIG. 2. ELECTRICAL PRECIPITATOR FOR RECOVERING LEAD, TIN AND ZINC FUMES FROM REVERBERATORY SMELTING FURNACES TREATING DROSSES

Electrical cleaning (dry) has been tried and a large installation has been under construction for some time. Unfortunately severe depression in the railroad industry has prevented the completion and operation of this installation. Here, again, the material is of little or no value, but the nuisance is probably not preventable. Earnest efforts have been made by the railroads to minimize such nuisance.

Much has been written on the indirect cost of black smoke nuisance, but for the purposes of this paper a review of all these public "losses" will not be attempted. The reader is referred to official reports of the cities of London and Birmingham, England, and Pittsburgh and Chicago in the United States.

Waste in Carbon Black and Lamp Black Manufacture

Studies of the smoke and soot ultimately called attention to the problem of waste in carbon black and lamp black manufacture. Present methods of production and recovery are quite inefficient. In carbon black alone less than 1 lb. of black is produced per 1,000 cu.ft., natural gas containing at least 33 lb. carbon in the form of hydrocarbons. These finely divided carbon particles can be readily precipitated electrically, and the electrical precipitator may be readily adapted to conform with other processes devised to increase the yield of such carbon black or lamp black. The next five years should accomplish rather radical changes in this industry, if developments at present under way are ultimately a commercial success. For an equal production of carbon black the investment saving will be easily one-half, the cost of production per pound will be one-half, and the natural gas consumption one-quarter (or less) of present methods.

Elimination of Waste in Sulphuric Acid Plants

Referring again to the chemical industries, the cleaning of hot sulphur dioxide gases from the roasting of pyrites for the production of sulphuric acid is an example in which the elimination of waste is indirect. The saving in this case is mainly one of labor and maintenance—power also to some extent. In chamber acid plants there would also be a saving of niter. In contact acid plants, cleaning of subsequent equipment would be less frequent. A total saving in production cost of, say, 25c. per ton acid produced amounts to a large sum annually in a relatively small plant.

After such sulphur dioxide gases are cooled another problem presents itself in contact acid manufacture—namely, purification. Here again a saving can be made by introducing an electric precipitator, obtaining practically perfect removal of all suspended acid mist or other suspended impurities, thereby increasing the life of the catalyst, or at least eliminating the necessity for frequent replacement of expensive filter media or the inclusion of large and expensive filter boxes or towers. In actual commercial operation, over 99.5 per cent removal of such suspended matter has been obtained continuously, using electrical precipitation.

Adaptation of Process to Combustible Gas Cleaning

Considerable development has been necessary to adapt these processes to combustible gas cleaning, but a

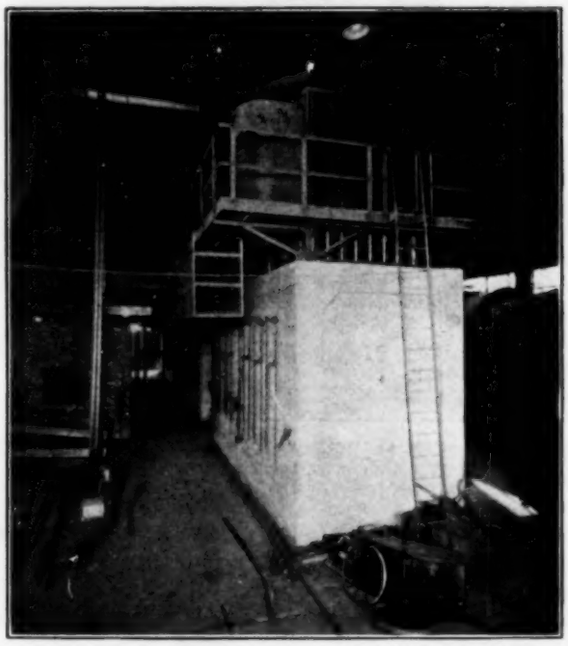

FIG. 3. ELECTRICAL PRECIPITATOR FOR RECOVERING TIN FUMES FROM REVERBERATORY, CALCINING AND BLAST FURNACES HANDLING TIN ORES

marked degree of success has followed these efforts. Here also the waste eliminated is primarily a labor waste, both in operation and maintenance, as well as a power waste. The dry hot cleaning of iron blast-furnace gases presented several features important from a waste standpoint—labor saving in operation and maintenance, water waste and stream pollution, fuel and power saving and, during the war, potash

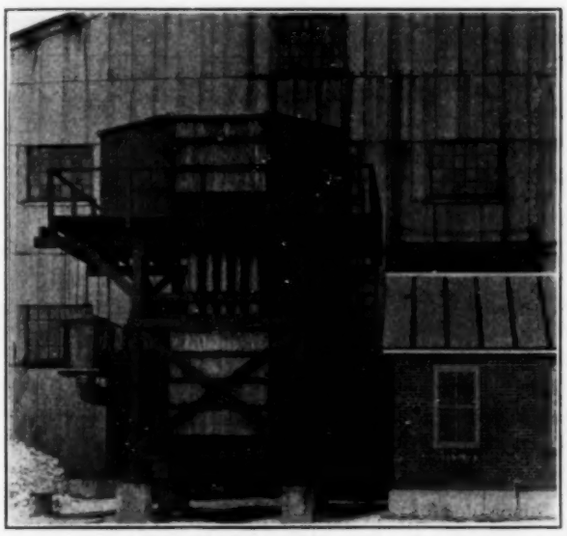

FIG. 4. ELECTRICAL PRECIPITATOR FOR RECOVERING SULPHURIC ACID MIST FROM EXIT GASES FROM A 50-60-TON O. V. CONCENTRATOR

recovery. Two installations built in the United States indicate the possibilities in this field and have shown at the respective plants considerable labor saving on hot stove maintenance, together with appreciably higher stove temperatures. It has been shown by actual statistics that the blast furnaces of the United States could easily produce an amount of potash sufficient for all usual peace-time purposes. It is not the purpose of this paper, however, to discuss the potash situation, which is a complex one. Factors such as transportation rates, availability, first importance of related operations of an especially severe nature, etc., must be carefully studied to determine the final safe economic procedure. Suffice it to state that some potash can be and is being readily obtained in this way and that the isolation of blast-furnace potash by electrical precipitation could be utilized in an emergency. Potash from cement kilns was produced in large quantity during the war, and several large cement plants were operated primarily for their potash recovery with the cement as a byproduct. Rotary kiln treatment of various potash-bearing shales and slates, with electrical precipitation of the volatilized fumes, has also been shown to be feasible and a means of obtaining an economical production of potash. Should imported potash remain at a low figure indefinitely the work done on potash recovery has not been lost, having served a valuable purpose during the war and demonstrated the practicability of "concentration by volatilization," which finds uses in metallurgical and other fields.

Another Field for Electrical Precipitation

The removal of dust and tar from gases of distillation of coal or from producers has offered another large field for electrical precipitation. Fuel and labor saving can be effected thereby, depending on a wide range of operation of such equipment. By temperature control fractional condensation may be obtained, saving certain redistillation operations, securing better grade byproducts, etc.

Examples could be given ad infinitum of possibilities and of accomplishment through the introduction of the Cottrell processes into industry, but the intent of this review is to give a perspective of the extent of the problems encountered, and the trend of thought and effort directing the development of such processes as a useful instrument in the control of industrial waste. It has been shown in the investigations of various "smelter smoke" commissions, mainly the Selby Commission and the Salt Lake Commission, that if noxious gases are first cleaned to remove their suspended matter and then discharged at a high elevation and at an appreciable temperature above atmosphere, such gases will be dissipated more readily than uncleaned gases and will not do appreciable damage to vegetation. Here again the Cottrell process plays an important part, cleaning the gases without appreciable interference with natural stack draft.

Development of engineering design for electrical precipitation, with or without previous research work, must follow the trend of general industrial progress, and to the end that duplication of effort be avoided and the greatest progress made, there is quite close co-operation and collaboration among all those interested in its development throughout the world. Standardization of design for specific applications tends toward simplification of equipment requirement. Design has therefore largely followed practical commercial results, and has been almost purely empiric, but rational methods must obviously follow, indicating what limitations may be expected in miscellaneous additional applications that may be presented.

Some Figures as to Cost

Owing to the wide range of application and size of Cottrell installations, it is well-nigh impossible to give any individual set of figures on the investment necessary or the cleaning cost. The following figures, however, will serve to show what may be expected. They are compiled from plants actually built and operated during the past five years:

Complete installation investment per cu. ft. treated per minute (at temperature of treatment)	$0.30 to $3.75
Capacity of installations, cu.ft. per minute	200 to 3,000,000
Power consumption, kw.-hr. per 100,000 cu.ft. per hr	1 to 2
Labor cost per 100,000 cu.ft. cleaned per hr	$0.007 to $0.02
Space occupied by precipitator per 100,000 cu.ft. per hr. cleaned	500 to 1,000 cu.ft.
Precipitation efficiency obtained in commercial plants	90 to 99 + per cent

The table on page 432 illustrates the actual capacities of individual installations.

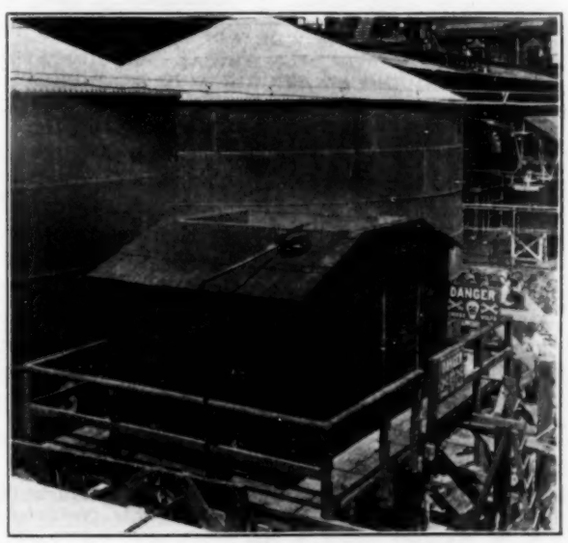

FIG. 5. VIEW WITH "POWER OFF" OF PRECIPITATOR FOR REMOVING SULPHURIC ACID MIST FROM EXIT GASES FROM O. V. CONCENTRATOR

CAPACITIES OF INDIVIDUAL COTTRELL PROCESS INSTALLATIONS

	Metallurgical Dust and Fume (Large Installation)	Metallurgical Fume	H_2SO_4 and Precious Metals	H_2SO_4 Mist	Precious Metal Fume and Dust	Metallurgical Fume and Dust	Air Cleaning (Gold Dust)	Metallurgical Dust	Metallurgical Dust	Pyrite Burner Dust	Producer Gas (Tar)
Investment per cu.ft. gas treated	$0.50	$2.38	$3.75	$3.75	$2.85	$2.50	$0.95	$1.50	$0.67	$3.75	$3.00
Cleaning cost per 100,000 cu.ft. gas treated per hr	$0.03	.13	.22	.25	.23	.175	.08	.08	.03	.155	.15
Temperature of gases treated	250–300°F.	600–700°F.	150°F.	150–200°F.	650°F.	600–700°F.	70°F.	400–500°F.	300–400°F.	900–1,000°F.	70°F.
Power consumption, kw.-hr. per 100,000 cu.ft. gas treated per hr	0.3	1.6	2.8	2.0	2.4	2.0	1.0	1.0	0.2	0.1	1.25
Cleaning costs per 100,000 cu.ft. gas treated at 70 deg. F.	$0.05	$0.26	$0.25	$0.30	$0.48	$0.35	$0.08	$0.14	$0.04	$0.50	$0.15
Weight of gas treated in tons per hour, approximately	4,000	50	26	8.4	8.0	14.4	53	66	270	18	5
Efficiency of removal of suspended matter	85–90%	98+%	99+%	99+%	99+%	97+%	95+%	95%	91%	99%	99%
Weight of precipitate in lb. (av.), per 100,000 cu.ft., approx	6	16	5–15	125	3	8–10	1.0	40–50	.....	7.5	15

NOTE.—Gas volumes taken at temperature of treatment, except where otherwise specified.

The foregoing outline indicates in general what has been done in the past few years, and can be done to an even greater extent in the future, toward the curtailment of industrial waste in the field of gas cleaning (for use in various operations) or for the prevention of atmospheric pollution. Close attention to all of the various factors entering into the solution of these problems is essential to ultimate success both technical and

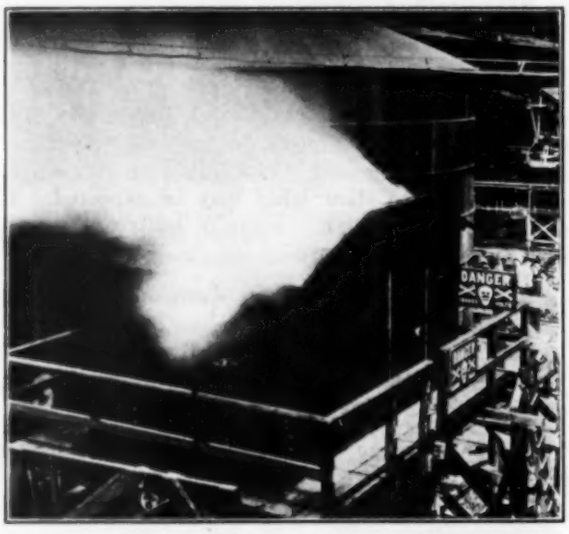

FIG. 6. VIEW WITH "POWER ON" ILLUSTRATING THE EFFECTIVENESS OF ELECTRICAL PRECIPITATOR FOR REMOVING SULPHURIC ACID MIST FROM EXIT GASES FROM O. V. CONCENTRATOR

economic. By conservative consideration of these problems as they arise much good may be accomplished, reacting favorably on the industry affected, creating new processes, making certain commodities more readily available, or assisting in the general betterment of public health and property to the end that the needs of our modern civilization may be cared for and even anticipated without appreciable detriment to anyone—the industries, the workers, or the public. Progress in this direction will therefore be slow, but if properly directed should be continuous.

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New York, N. Y.

Waste and Inefficiency in the Industries

A Series of Short Articles by Industrial Leaders Featuring the Outstanding Causes of Waste in More Than a Score of Industries—Frank Confessions of Inefficiency Due to a Wide Variety of Causes

EDITOR'S NOTE: It is not often that technical executives will speak frankly regarding the weak spots of their industries. They may recognize them clearly and work assiduously to eradicate them, but they are apt to prefer not to talk about them, at least for publication. Accordingly the series of short articles presented herewith assumes a degree of importance that is not likely to be overestimated. Men fully familiar with the industries whereof they speak and fully cognizant of the necessity for eliminating waste and inefficiency have frankly laid bare the conspicuous weak spots. The reader will be struck by the variety of causes assigned by different writers. Lack of statistics, rule-of-thumb operation, lack of team work, lack of technical men and their engineering knowledge, poor management in high places—these are a few of the causes assigned.

A careful reading of the entire series will prove valuable to every chemical engineer regardless of the industry in which he is engaged. He has before him, in effect, brief reports of competent investigating committees whose findings may be accepted at their face value because in some instances they are the butt of their own criticisms.

The Wastes Caused by Carelessness

BY PHILIP DEWOLF
Davison Chemical Co.

If a job is done exactly right, which, of course, means that there are no mishaps of any kind, the result will be 100 per cent of the possible. That does not mean a 100 per cent yield in any chemical process, because chemical reactions go only to equilibrium anyway; also the last few per cent may cost more than they are worth, so cannot be considered within the limits of commercial possibility.

But the greatest enemy of the proper yield is lack of thoroughness. We all make mistakes; we all forget, and the only way to get the yield the greatest number of times is to cultivate the habit of thoroughness. It can't be taught—it must be learned.

CONSPICUOUS WASTES DUE TO LACK OF THOROUGHNESS

Let me give a few examples of troubles from this cause that have come within my experience.

During the war at a munitions plant oil-of-vitriol lines were put into service with bewildering rapidity, and each one started off and ran well until the very last one. And when the pumps were started in it every member of the crew was burned—not a wrench had been put on the flange bolts of the acid lines in the absorber house—someone had not been thorough.

A copper smelter was built 11,600 ft. above the sea, in the mountains of Peru. It was designed by an engineer who had built six large and successful smelters, and, while of moderate size, was supposed to be the last word. The river furnished just sufficient power to operate the machinery provided. When the metallurgist started to figure his charges he couldn't get them to come out right—the designer had forgotten that at 11,600 ft. the barometer stands at 19 and 50 per cent more air, by volume, is necessary. That meant a new power plant further down stream—pretty costly lack of thoroughness.

This same smelter, owned by one of the largest and most successful copper companies in the world, was fed by many small mines, and before the last power house was finished a flaw in a group of titles was found, and the company abandoned its $2,000,000 investment—a high price to pay for a careless lawyer.

One of the big munitions plants decided to use marl for neutralizing its wash water before releasing it to the river. One large body of marl was available, soft enough to be a steam-shovel proposition, but it had the drawback of roundabout transportation. So another "marl" deposit was found and bought. It was in rock form, so an expensive crushing and distributing system was installed at the plant. The first few hopper-bottomed cars arrived; the pieces of rock were so large they would not discharge through the hoppers and had to be unloaded by a crane, and were so hard that every crusher tried was broken. So without getting one pound of "marl" into the river this $150,000 plant was abandoned because the engineer had satisfied himself as to transportation and chemical composition, but had paid no attention to physical condition nor to crushing facilities at the quarry.

THOROUGHNESS PAYS IN THE CHEMICAL PLANT

One very much used war chemical was bought by the Government at 50c. a lb. One of the large manufacturers made it at 19c. a lb., but some smaller contractors, without the technical skill available to the larger one, could not make it for 50c. So a "flying squadron" of good men was organized by the big maker, and was sent around to the smaller plants to cut costs and help production. In almost every case the trouble was found to be insufficient washing, and in every case costs were cut well inside the 50c.

At the 15,000-hp. boiler plant of one of our big chemical companies steam costs 26c. a thousand pounds, while at the best of the boiler plants of a still larger company it is 90c. To be sure, the larger company has no very large individual plants, but neither does it begin to pay the same attention to water softening, proper combustion of fuel, or other smaller but in the aggregate by no means unimportant items. The first company's thoroughness pays.

Examples could be given almost without end, but they would all point to the same thing—viz., how much it costs not to be thorough.

Baltimore, Ohio.

Dye Industry Lacks Business Knowledge

BY "INSIDER"

The manufacture of coal-tar intermediates and dyes is just like any other business, and suffers from the same business diseases. The great variety of products, coupled with an uncommon complexity of manufacturing practice, complicates the symptoms and intensifies ordinary business troubles to a degree not met in the usual industry. This is, however, merely an intensification, and nothing new or mysterious.

"WE DON'T KNOW OUR BUSINESS"

The principal cause of waste in the dye industry today is lack of knowledge of the business by those engaged in it! Horrible confession, we don't know our business, but it's true! This lack of knowledge is monopolized by no one group, but is common to all.

Beginning with the financier, we find a startling lack of appreciation of the risks of the business to which he pledges his resources and the normal ways of minimizing them. Common gambling would represent a true definition of his activities in most cases. Next, of red tape artists suppliant before a mysterious scientist we have had plenty, but the understanding organizer is still absent. Chemists of good training are ever present, but their dyestuff experience is attested by the prevalent low yield figures. Lack of plant discipline is indicated by a watch at our plant sewers—it's an even chance that the operating man either lets the batch by, or finds it desirable to dump it. As for the dyestuff engineer, he is still a dream. Witness our hodgepodge plant equipment and the primary failure to utilize expensive manufacturing equipment and buildings for manufacture rather than for storage. Again, where is the counterpart of the time study of the metal industry?

This view may be called extreme, but space does not permit amplification. One ever-present fact is very indicative—in no branch of the business can a full answer be given to a question without an extensive investigation, not only into the subject matter of the question itself but also into the underlying fundamentals. Commonplace knowledge of the latter is unavailable to most in this business; how then can we be said to know it?

In the past, circumstances have been largely to blame for this lack of knowledge, but we ourselves will be entirely at fault if we fail to correct it in the near future. Some companies have made a considerable advance already, but it is believed the picture here given is true of the average organization.

FINANCIAL, EXECUTIVE AND TECHNICAL PERSONNEL NEEDED

Assuming that we obtain from the public an indication of probable continued support, we must attract to the industry broad-gaged financial men to head our companies, who are willing to lay out a long-time manufacturing program and who are able to back it, even if it means waiting several years for returns. These men must further attract broad-gaged executives who are willing to learn the business and who realize that it takes time and money to build up an art. Chemical engineering, operating and commercial research must be undertaken in a systematic manner, and if the industry is to progress, this research must be undertaken by permanent employees of the companies involved. Letting the other fellow experiment, and if he goes bankrupt, buying his results at a discount; or, if he succeeds, stealing his men, must cease. Freer interchange of general technical information between companies is an important desideratum. The perfection of organization and methods compelling the quick seizure and immediate utilization of the results of this research is essential. A policy of encouraging and assisting in the development of subsidiary industries, such as chemical machinery manufacture, should be practiced. Finally, we must welcome any methods which will tend to rob the industry of its mystery and thereby render available to it the recognized standard practices of other industries.

Thus can we be sure that we have learned our business, and thus only can we rid ourselves of the charlatan, the mysterious alchemist, the get-rich-quick schemer, the possessor of fake processes and the bribe-giving salesman. And when we have learned our business we will not be afraid to think of next year, and spend perfectly good money *now* preparing for it.

The Rubber Industry Learns Its Lesson

BY ANDREW H. KING

When the topic of waste is first mentioned, one usually thinks of some small insignificant dribble which if allowed to continue will eventually consume a large share of the profits. There is, of course, this type of waste in the rubber industry. However, through the work of alert salvage departments this loss is kept at a minimum.

But unfortunately there is such a thing as "saving at the spigot and wasting at the bung." For waste exists in high places as well as in the low. It is of waste in the high places that I wish to call your attention.

DISREGARDS THE WARNINGS OF THE ECONOMIST AND STATISTICIAN

In common with several other industries, rubber is now recovering from a very serious attack of indigestion, which in the business world is known as overproduction or overexpansion. Losses have reached almost incredible heights. A number of firms have gone into receivers' hands, while others have been forced to undertake plans of reorganization, which in one or two instances could hardly have been more rigorous.

As mentioned in the beginning, the writer feels that the severity and extent of the disaster were largely due to waste in high places. The first and probably the most unpardonable sin was the almost wholesale disregard of the opinions of the economists and statisticians. For at least a year before the "flood" one prominent financial intelligence organization was crying: *"Beware, the end is at hand."* Few listened, but the majority kept right on with their overproduction and overexpansion as if nothing could ever happen that would puncture their soap bubble of prosperity. They were drunk with their own success.

WANTON SPENDING WITH NO EYE TO THE FUTURE

The second mistake was that very few firms laid by a rainy day fund. And such that did found their estimates wholly inadequate. Perhaps they thought it would never rain. Throughout the period of prosperity there was very poor control of spending. Purchases of all kinds, contracts for future delivery, new build-

ings, new machinery and new equipment were authorized with almost no check as to their need. The executives who should have been on the job were asleep.

Not only was there no respect for statistics as to general business conditions but there were no authentic statistics relative to their own business. Years ago a writer estimated that the average car consumed five new tires per year. This figure misled many who should have known better from their own experience if from nothing else. The estimate above mentioned was made when all tires were "fabrics." Today they are nearly all "cords" and the mileage has been multiplied by at least two and in many cases three or more.

Then again the art of repairing tires has made wonderful progress within the past few years. Today an accident to a tire no more spells its funeral than an accident to a car. New parts are placed in each.

The severe retrenchment which followed has brought once more a healthy condition to the rubber industry. It is hoped that the lessons have been well learned.

New York City.

Technically Trained Men, the Need of the Food-Preservation Industries

By W. V. Cruess

Assistant Professor of Fruit Products, University of California

Many companies engaged in food preservation spare no expense for up-to-date equipment and buildings. Often their sales and advertising departments are given the fullest support. Yet these same companies all too frequently intrust the management of production to men who have had no scientific training and who in many cases are opposed to the application of science in the plants under their control. In other cases a small amount of money is appropriated for a laboratory and for a chemist who is expected to return several thousand per cent on the investment at once; or the chemist becomes merely an unimportant adjunct to the advertising department. Both of these viewpoints are wrong.

Chemists and Bacteriologists for the Canning Industry

The food-preservation industries are above all else badly in need of scientifically trained and experienced plant managers. Of almost equal importance is the need of well-equipped laboratories manned by high-class research and control chemists and bacteriologists. The National Canners Association has been of immense value to the canning industry. The value of the research work and control measures accomplished by Dr. W. D. Bigelow and his associates cannot be overestimated. Yet in the canning industry itself we have need for hundreds of university-trained men in production, research and control, if the canning industry is to come into its own.

The need is even greater in the pickling, beverage and fruit drying industries. That investment in scientific training and skill pays has been amply proved by such organizations as the H. J. Heinz Co., the Campbell Co. of Campbell's soup fame, the Van Camp Co. and others that could be mentioned.

Must Start at the Bottom

The food-preservation industries are not entirely to blame for the present condition. Too few of our university graduates are willing to enter the plants at the "bottom of the ladder." It will be necessary in many cases for them to don a pair of overalls, learn present factory methods and strive for the superintendency or management of the plants. Observation has shown that such men usually advance rapidly. Once this pioneer work of establishing technically trained men in industry has been done, research and plant control will come quickly and naturally, to the great benefit and advancement of the industries concerned.

Berkeley, Cal.

Industrial Waste of Food Products

By G. A. Menge

Libby, McNeill & Libby

Considering industrial waste from the standpoint of failure to conserve and utilize byproducts to the best advantage, the food industry in general is perhaps less deliberately guilty than some other industries, considering that it is still largely based upon rule-of-thumb methods. Perhaps the broadest opportunity in the food field for waste of this kind exists in the great meat-packing industry, but whatever just indictments may be found against that industry it is a well-known and very generally recognized fact that indifference to industrial waste is not one of them.

Important Food Products Wasted

In other branches of the food industry, however, the total aggregate waste resulting from failure to conserve and utilize most efficiently such valuable material as skim milk and buttermilk in the operation of creameries, whey in the operation of cheese factories, sound culls and other discarded material of like nature in the food-canning industry in general and in the fruit industry in particular would undoubtedly reach staggering proportions. More or less numerous and intensive studies now in progress on some of these problems will doubtless result eventually in much greater conservation and more effective and economic utilization of such waste materials than is true today.

If, however, we apply to our text sufficiently comprehensive interpretation to include waste or losses resulting from avoidable spoilage of manufactured food products, the food industry becomes involved in a tremendously serious indictment.

Wastes Through Mismanagement

If my experience in the food industry is typical and my observations accurate, waste through preventable spoilage in this industry is often directly traceable to inefficient management in one or more or all of the major functions of the industry, from central administration to selling, including manufacture and distribution as well as all functions incidental to these. Lax and inefficient management at any major point in the industrial path, especially in central administration—the hub of the industrial wheel—is almost inevitably reflected, generally in aggravated form, at all other points. Conversely, a high degree of efficiency in any one major function, especially in central administration, will surely induce favorable reaction all along the line. Obviously the scientific development of a strong organization, with sharply defined and closely co-ordinated functions, adequately controlled and checked and under the responsible leadership of thoroughly qualified men, is the remedy for waste through mismanagement.

Perhaps the largest proportion of preventable waste through spoilage in the food industry is due to rule-

of-thumb or unscientific methods of manufacture. To the extent that this is true such waste, in my judgment, can be very largely prevented by drawing more generally and more intelligently upon thoroughly qualified technical and scientific service, with capable, efficient and responsible representation in the administrative organization. It is my firm conviction, the opinion of most so-called practical men to the contrary notwithstanding, that the personnel of every food-manufacturing plant should include a man of such thorough technical training, in scope and degree, as to qualify him to recognize the sources of danger, often very subtle and insidious, to prescribe and apply proper and adequate protection when possible and to give competent scientific advice and help in the various technical phases of plant operation with respect to the food product involved. Such service in such degree, in my judgment, expresses the principle of proper scientific control in the food industry in its simplest terms. Elaboration of it may be indicated with great advantage in specific cases.

Disastrous experiences of an economic nature now and then in the food industry have gradually forced some degree of application, as well as recognition of the value, of scientific methods and control as a means of insuring safety, improving quality and greatly reducing waste of manufactured food products, but we still have a long road to travel before this development is complete.

Chicago, Ill.

Causes of Waste in the Textile Industry

By One Who Knows

One of the most apparent reasons for the waste that occurs in the textile-manufacturing industry is the status of intermittent operations which obtain in practically all divisions of this trade. In the majority of plants this spasmodic activity is caused by seasonal conditions which make for an abnormal rush during certain periods and equally abnormal idleness at others. The result is that manufacturers are not able for the most part to figure on 100 per cent capacity in calculating their costs, but must take into consideration the overhead of idleness.

This condition leads naturally to more or less discontent on the part of operatives, who cannot be assured of year-around employment, with the consequence that labor turnover is thereby increased and cost enhanced. To this may be added the liability of labor difficulties, which are more or less recurrent in the textile industry and which frequently last for a protracted period.

It is also apparent in the textile trade that there is a lack of planning ahead in the various operations of the mill. This produces a certain amount of idle machinery that could be utilized to advantage if plans were made to provide a continuous process from one step to the next. This lack of foresight also increases overhead.

Better Cost Methods, Technical Research and Economic Distribution Needed

It must be admitted that the textile industry shows no general inclination to adopt up-to-date or standardized cost methods. Naturally there are exceptions to this statement, but those manufacturers who are content with methods long discarded are sufficiently numerous to characterize the industry as being decidedly backward in this respect. The effect of this apathy is far-reaching and accounts in a measure at least for much of the speculation and wide range of prices which is frequently noted in the selling markets. Another feature that is not complimentary to this industry is the small amount of technical research work that has been done in the past, though it must be admitted that more attention is being paid to this subject, and the hope for increased efficiency through better technical knowledge of materials and processes is widely entertained.

The uneconomic methods of distribution might be touched upon, though this is going somewhat afield in a strict discussion of waste in the manufacturing industry that goes no further than the production of the fabric. The passage of manufactured product through many hands means an accumulation of profits for each handler and an enhancement of cost which is an economic waste to the ultimate consumer. Here also, however, the tendency is apparent of a more direct contact between the manufacturer and the consumer of his product.

Inefficiency in the Leather Industry

By John Arthur Wilson

Chief Chemist, A. F. Gallun & Sons Co.

The most conspicuous cause of inefficiency in the leather industry is ignorance of the basic principles of tanning. As many as fifty distinct operations may be employed in converting the raw material into finished leather, when perhaps less than half of the enormous amount of labor and materials involved would yield a better leather, if only the relation of each operation to the entire process were sufficiently understood.

Unnecessary Increase in Tanning Operations

Present methods of leather manufacture are largely the result of centuries of hit-or-miss juggling. By chance someone would discover that the introduction of a new operation caused an improvement in the final leather, but little realizing that the new operation merely counteracted the bad effects of some other operation that was either unnecessary or improperly conducted. It is like using alkali at one stage and an equivalent amount of acid at another when a neutral solution is desirable at all stages. Eliminating acid or alkali alone would cause trouble, whereas time, labor, materials and an improved product would be gained by eliminating both acid and alkali. The new operation might cause an improvement in some respects and introduce difficulties in others, requiring the introduction of still further operations for correction. Thus the tendency has always been to increase rather than decrease the total number of operations, and chiefly through ignorance.

Adding Soluble Matter and Then Removing It

A glaring example of this sort of thing is found in a certain manufacture of heavily greased leather where a tanner treats the hides in the final stages of tanning with very concentrated liquors to get an increase in weight. The large amount of soluble matter now present prevents the greases from penetrating the leather. His method of overcoming this difficulty is then to remove the excess of soluble matter by a scouring operation instead of ceasing the practice of loading the leather with concentrated liquors. He does not appre-

ciate the fact that the concentrated liquors caused the trouble nor that the scouring operation corrects it by removing the excess of soluble matter.

Must Recognize Value of Chemical Technology

Incorrect beam-house methods necessitate corrective operations in or prior to tanning, just as crude systems of tanning increase the number of operations required in connection with fat-liquoring, stuffing and coloring. Often costly materials are wasted because their functions are imperfectly understood or because it is not known how to strengthen a used liquor so as to give it the properties of a fresh one.

The ultimate cure for this state of affairs lies in an intensive study of the nature of the interactions between and the physical and chemical properties of proteins, enzymes, tannins, emulsions, dyestuffs and electrolytes, followed by an intelligent application to tannery processes. Unfortunately the industry as a whole has not yet awakened to the value of such study and apparently still doubts that an increased knowledge of chemistry will result in any great increase in the efficiency of the tannery. Some will probably sleep until it is too late to meet competition.

Milwaukee, Wis.

Meat-Packing Industry Contributes Too Much to Fertilizer

By L. M. Tolman
Chief Chemist, Wilson & Co.

The meat-packing industry has been noted for its attempt to utilize in some way every byproduct of the animal, and to a very great extent this has been done especially by the larger companies. It has, however, been realized for some time that a great deal of the material going into fertilizer could be utilized in some more valuable form—particularly is this true of the nitrogenous waste. At the present time it might be said that the most outstanding waste in this industry, if it may so be termed, is the material which goes into fertilizer. This material if it had been handled in the proper way might be made into either food products or into certain technical products, such as gelatine and glue.

Better Utilization of Blood

An example of the proper utilization of nitrogenous material could be well illustrated in the handling of blood. Blood consists of serum and red blood corpuscles, which can be separated to produce, in the case of the serum, a product known as blood albumen, which is of great value as a water insoluble glue and finds important uses in the textile industries. The red blood corpuscles consist largely of hemoglobin, which has been found to be of value in medicine. So it is that two valuable products can be made from a material which was formerly used almost entirely as dried blood for fertilizer. Moreover, it is undoubtedly a waste not to use blood for human food.

Faulty Handling Degrades Valuable Materials

Tankage should be considered similarly. Here we have a material carrying from 40 to 60 per cent protein. At one stage in its handling it was largely an edible product (except where it came from animals which were condemned on account of disease), and it was only the faulty handling that has degraded tankage into an inedible fertilizer substance.

In a general way it might be said that the greatest waste now apparent in the packing industry is that which is brought about by spoilage or so degrading high-grade edible or technical materials until they are only useful as fertilizer.

Recent developments in the field of medicine have indicated that many valuable medicinal substances can be prepared from the glands and organs. Undoubtedly the developments of the future will be along the lines of utilization of all of these substances and their manufacture into the very highest grade of pharmaceutical preparations.

Chicago, Ill.

Waste in the Glass Industry

By E. Ward Tillotson, Jr.
Assistant Director, Mellon Institute of Industrial Research

Some years ago a writer aroused the indignation of glass manufacturers by stating that, despite much excellent management and notwithstanding the use of many ingenious machines, the main policy of the glass executive was to be described by the slogan, "Save at the spigot and waste at the bung." This expression, derived from a defunct industry, may divert the attention of the present reader from the main theme of this contribution and to some, in fact, the analogy may be quite unintelligible. The thought to be conveyed was that the manufacturer failed to recognize the necessity for obtaining certain essential information the lack of which often resulted in the loss of production for a considerable period of time or at least in the manufacture of an inferior product. The loss of a tank of glass due to the use of materials the unsuitability of which would have been indicated by chemical analysis was a case in point.

Glass Manufacturer Requires Facts

The same thought has been expressed recently to the writer by a prominent and successful glass manufacturer, who, speaking of the industry at large, says:

> We neglect facts; we reach decisions and take action without the readily available facts which bear on the matter in question or else we do nothing because the facts which would stimulate to action are not at hand. This is true not only of such information as physics or chemistry or mathematics can supply, but also of the facts which a study of simple records would reveal in the individual plant.

Wastes Due to Management and Operation

Waste in the glass industry is of two sorts: The first type of waste results from the lack of proper management and is represented by poorly planned factories, inadequately constructed buildings which provide unpleasant and in some cases unhealthful working conditions, carelessness on the part of the workman, the improper selection of raw materials and the lack of standards for them, and the use of cheap labor for important operations such as the care of the gas producers and the regulation of the furnaces. As an instance, the owner of a small factory states that the systematic reading of gas meters and the constant checking of the proportions of gas and air entering the furnaces have resulted in a daily saving of 150,000 cu.ft. of gas.

Wastes Due to Materials

The second kind of waste is due to fundamental limitations of materials, particularly of the refractories, which necessarily are employed. No really satisfactory substance is available for manufacturing those parts of the furnace which come in contact with

the melting glass or for the "crown" and other parts of the furnace. The refractories not only are dissolved slowly by the molten glass but also have a softening temperature only slightly above that of the furnace. Indeed, if the whole mass of the refractory block were to be heated uniformly to the temperature of the furnace, it would soften sufficiently to allow the structure to collapse. Consequently it is impossible to conserve fuel by insulating the furnace; but, on the other hand, it is necessary to increase the radiation (which amounts to around 40 per cent of the total fuel) by cooling the exterior by artificial means. Much of the product which is rejected, the "shrinkage," is discarded because of faults which may be traced back, either directly or indirectly, to the construction or operation of the furnace. Excessive loss of product also is caused, at times, by an occasional use of unsuitable batch materials and by a lack of control of the temperature in the leer.

To Place the Glass Industry on a Scientific Basis

The glass industry, certain branches of which owe their present status to engineering, will eventually meet its problems in waste through the infusion throughout the industry of the principles of science, not only in the way of research and control from the standpoints of chemistry and physics but also in considering questions of hygiene (including the prevention of contagion, poisoning and injuries) and in placing the several operations and, in fact, the entire organization on a scientific basis. That the more successful glass manufacturers maintain intensive investigations of these and other problems is significant.

Pittsburgh, Pa.

Improvements to Be Realized in the Cane Sugar Industry

By C. E. Coates
Dean Audubon Sugar School, Louisiana State University

The manufacture of sugar from sugar cane when carried out properly in the most modern plants is exceptionally free from waste. The cane is weighed, the juice is weighed, the resulting sugar and molasses are weighed, and there is a loss unaccounted for of only a fraction of 1 per cent. From a mechanical standpoint, the steam pipes are insulated, the furnaces are provided with suitable gages and there is a heat recovery considerably above the average. The engine work is good, mills are efficiently run, the evaporation is carried on in triple and quadruple effects, graining is done in insulated pans and every effort is made to conserve heat by economizers and the like. Where any of these twentieth century devices are lacking or inadequately provided for, loss in both sugar and in heat is bound to occur.

On the whole, the greatest waste is in the mechanical end, because the economy of high-grade and therefore expensive mechanical engineers is not thoroughly appreciated. The chemist, on the other hand, is generally considered indispensable, and waste from inversion or from molasses of too high purity is not usual. The bacteriologist, however, is just beginning to be appreciated and considerable avoidable loss occurs from lack of consideration of his possible services. Fermentation frequently does more damage to the sugar house itself than is ordinarily known and finished raw sugars lose materially in transit, because of inversion due to a number of different avoidable fermentations.

Need of Better Utilization of Bagasse and Molasses

Perhaps the greatest waste occurs in the utilization of the byproducts, which are bagasse from the fresh cane and molasses.

Bagasse is ordinarily burned. As a fuel a ton is worth about one-fourth as much as a ton of coal. It would have a considerably higher value if made into building board or paper stock. It is also possible to separate it chiefly into pith and fiber and from the pith plastics could readily be made. The economies have been effected only in isolated instances. Molasses can be fermented into industrial alcohol, and from this motor spirit can be made. This industry is at present quite promising. Molasses may also be used as a cattle feed, and this is done to a large extent. There seems to be no reason, however, why final cane molasses can not be made of such a quality that it would be also fit for human consumption. Comparatively little attention is paid anywhere to quality at this point.

The real waste in the cane sugar industry, and it is a waste of great magnitude, lies in the fact that much cane sugar is made by a rule-of-thumb method, with little consideration given to the teachings of applied science.

Baton Rouge, La.

Basic Technical Information Needed by the Edible Oil Industry

By John C. Ingram
Development Engineer, Morris & Co.

An article dealing with the elimination or minimizing of waste in any industry is essentially a dissertation on the basic problems of that industry, and these are naturally receiving some attention from all those actively engaged in the industry. In the edible oil industry the precipitous decline of prices without any possibility of a corresponding decline in costs has brought about so-called economies which have tended to interrupt somewhat the progress being made in the solution of its fundamental problems. Work on the accumulation of basic technical information seems to have been indefinitely postponed and only those problems which promise immediate financial reward are being given any considerable attention.

From a host of pressing problems the following may be selected as typifying the trend of the present-day effort toward the elimination of waste in the several principal processes of this industry.

Problems of Crushing

About 85 per cent of the edible oils of the country are produced primarily by the cottonseed crushers, who are confronted with the difficult problem of reducing the idle time of their numerous plants. The operating time of cotton-oil mills varies with their location and with the seasons, approaching six months as a maximum, while some have been known to operate but six weeks out of a year. The widespread distribution of oil mills throughout the cotton belt enables the producers to handle between 60 and 75 per cent of the total production of seed, but the capital outlay required is nonproductive for the greater part of each year.

The reduction of overhead charges by increasing the

operating time of plants is the most pressing problem before the crushers today, and a number of solutions have been offered. A brief outline of several of these solutions together with a few comments are given below.

Reduction in Number of Mills and Storage of Seed

There can be noticed at present a tendency toward fewer mills of larger capacity, centrally located. The perfection of methods for the drying of cotton seed and the provision of adequate storage facilities promise some relief from the handicap of seasonal production. Part of the saving in freight on dried seed would be used to increase the mill's profitable working radius and the remainder to defray the expenses of drying and storage. Preliminary surveys indicate that the saving thus effected is distinctly worth while.

Supply of Raw Materials Other Than Cotton Seed

During the era of high prices an appreciable quantity of peanuts and soya beans were handled profitably by the mills, but under present conditions it is doubtful whether the working of these materials contributes much toward the solution of the dormant season problem.

The development of an adequate supply of foreign oil seeds and nuts gives promise of furnishing some relief to those mills which are favorably located. For some time certain importers have been offering small lots of these materials for experimental work with the view of developing these projects should the results prove favorable. It is well recognized by the leaders in the edible oil industry that the most likely source of supply is toward the south—in Mexico, Central and South America—and the materials which look most promising at the present time are sesame seed, cohune nuts and palm kernels.

Loss in Soapstock and in Fullers Earth

Like the proverbial cat, our old problem—the oil retention of soapstock—has returned with the era of comparatively low-priced oil, the war solution being no longer attractive when all cost factors are considered. This foots, or soapstock, selling around 1½c. per lb. still contains 20 to 26 per cent of 6 to 7c. oil. The refining process is in crying need of considerable study from the standpoint of colloidal chemistry.

Approximately 25,000 tons of fullers earth is used each year by the edible oil industry. The spent earth contains anywhere from 15 to 40 per cent of retained oil, depending on the type of earth. Some efforts are being made to recover the oil and some organizations are attempting to re-use the earth, but as yet no process has proved of sufficient financial interest to be universally adopted, and this material is still a liability.

Efficient Deodorization

This process, developed through decades of cut-and-try experimentation, is essentially the removal of odor bodies by distillation in steam. As such, the main item in its cost is steam, and attempts at cost reduction in this phase of the industry are very likely to aim at higher steam efficiency.

The main problems in deodorization are not connected with direct savings in the process, but with the elimination of waste, through the improvement in keeping qualities of finished oils.

Chicago, Ill.

Cement Industry Needs More Chemical Engineering

By John Godfrey Dean
Chemical Engineer

The cement industry has suffered from many of the so-called industrial ills such as overcapitalization, excessive promotion, poor locations, lack of systematic cost accounting, poor management, local overproduction, unreasonable competition, poorly designed plants, lack of "safety first" provisions, excessive power and fuel consumption, loss of dust and waste heat, etc., to the end of the chapter. Many of these disorders were general, some were more or less epidemic, and a very few were exceptional.

When we consider the rapid expansion that has taken place in this industry during the past twenty years, it is not at all surprising that it has suffered from the usual disorders of youth and inexperience.

Co-operation Displaces Selfish Methods

By certain processes of elimination, foreclosure and consolidation many of the above-enumerated abuses have been overcome. During the past few years, by a process of education fostered and encouraged by the Portland Cement Association, the industry has become nationalized to a certain extent and a real spirit of co-operation has taken the place of former selfish business methods. This has resulted in a mutual exchange of ideas and experiences. The elimination of waste and inefficiency of manufacturing, marketing and business management has been discussed openly and candidly with great benefit to the industry. In particular, the educational work and propaganda carried on in the interests of "safety first" and the statistical work of the association should be mentioned as being of special service to the industry.

In spite of the many improvements that have been made in machinery and manufacturing methods there remains a great deal to be done, especially in increasing kiln production and efficiency, a better understanding of the essentials of fine grinding, elimination and collection of dust, conservation of heat, reduction of power and labor requirements, and the recovery of byproducts from the stack gases, to mention a few of the more important problems.

Cement Problems Are Chemical Engineering Problems

It is my opinion that one of the essentials in the solution of these problems is the recognition of the fact that they are largely chemical engineering problems. In fact very few operations connected with the process of cement manufacturing are entirely mechanical or chemical, and it seems that in many instances proper consideration has not been given to the latter phase of the subject. In order to handle the large tonnage of material satisfactorily and economically the mechanical operations and equipment must necessarily be of a high order of excellence. However, since the ends attained by the various mechanical operations are so largely chemical, the chemical considerations should be of equal importance.

Many companies employ routine chemists and testers who have been recruited largely from the ranks with very little chemical training outside of what has been gained in the plant laboratories. The excellent practical experience of these men cannot be denied and on account of their more or less restricted responsibilities they have been able to meet the requirements. In order

to meet the requirements of the larger field of chemical opportunities better trained technical men are manifestly needed.

It quite often happens that a few degrees variation in the temperature of the drier atmosphere or a slight change in the physical condition of the materials or some other scarcely appreciable variation will materially affect the output and quality of the product. Again, certain methods of operation or certain types of machinery will give excellent results in one plant, while in a neighboring plant the same operations and machinery under practically the same conditions will be quite unsatisfactory.

These problems and many others of similar nature, and particularly the whole field of kiln operation, call for careful investigation and intelligent supervision by well trained chemical personnel. This, in my opinion, would hasten the solution of many of the problems peculiar to this industry and would play an important part in the elimination of waste and inefficiency.

Parma, Mich.

Wasteful Methods of the Naval-Stores Industry

By V. R. Croswell
Naval Stores Division, Hercules Powder Co.

The naval-stores industry of the United States produces about 25,000,000 gal. of turpentine and 834,000,000 lb. of rosin, with an approximate value of more than $40,000,000. About 90 per cent of this is produced from the living trees (the Southern long leaf yellow pine) by gashing the trunks and collecting in cups the oleoresin (gum) which flows from the wound. The remaining 10 per cent is obtained from dead wood and stumps of the same tree by destructive distillation or by chipping up the wood, driving out the turpentine by use of steam and extracting the rosin by the use of a solvent.

Seventeen Causes of Waste

The principal wastes in this industry may be summed up as follows:

1. Working young saplings. Government investigation has shown that the tapping of any tree less than 10 in. in diameter is a loss to the operator regardless of the market value of his products.

2. Poorly placed cups and aprons. On some workings as high as 20 per cent of the gum never reaches the cup due to improper condition or arrangement of the aprons and cups. This particular loss might conservatively be placed at 5 per cent of the gum for the whole industry.

3. Loss of volatiles through exposure of the gum. Probably more than 7 per cent of the turpentine evaporates from the gum before it is worked at the still.

4. Contamination of the gum. Dirt, bark, chips and needles falling into the cups (besides staining the gum and reducing the grade of rosin) will absorb a certain amount of this gum which is never recovered, although the foreign material is strained out at the still.

5. Loss of fresh gum through heavy rains. Fresh gum floats on water. After losing some of its volatile oils, it sinks in water. Heavy rains fill unprotected cups and occasion considerable loss in the fresh gum.

6. Improper chipping. Because of the character of their lease or their ignorance of the technical side of their work, operators often turpentine trees "to death"—a practice which materially reduces the amount of gum obtainable from the tree. Work done by the Forest Products Laboratory indicates that increased yields might be obtained by even shorter chipping than is generally considered good practice at the present time.

7. Coloring matter from poor cups. Metallic stains from cups lower the grade of rosin produced.

8. Improper distillation. It is the rule rather than the exception to run the still and worm condensers hot, and to use uncovered receivers for the turpentine. Much loss through evaporation is the result. Careless or unintelligent handling of this operation may cause the contents of the still to foam up through the condenser and start a fire.

9. Character of containers. The container constitutes 20 per cent of the weight of a barrel of rosin, which results in excessive freight charges for producers and consumer. No better container has been devised.

10. Unstable market. The naval-stores market is particularly subject to fluctuations. This condition of affairs increases speculation, encourages working young saplings and turpentining "to death," excuses profiteering to make a "killing," encourages low wages, discourages employment of technical men.

11. Method of financing. The factor backs the producer, the producer "stakes" his men on the future. Both take heavy risks and necessarily charge heavily to protect themselves.

12. Forest fires. The Southern pine forests suffer from this calamity as do our other forests.

13. Destructive distillation. In destructive distillation no attempt has ever been made to utilize the volatile gases.

14. In the steam-distillation process the spent chips are burned for fuel, although they could be made into paper after being expensively ground up and chemically treated.

15. Only about 70 per cent of the resinous material in the wood is extracted by the present solvents. The residual resinous material is, however, dark, and special uses would have to be found for it.

16. Solvent losses in the steam-distillation process are excessive.

17. The cost of gathering stump wood is increased 20 per cent by the general practice of taking downwood off the land at one time, and later returning to gather the stumps.

Gulfport, Miss.

Production Wastes in the Ceramic Industry

By R. H. Minton
General Superintendent, General Ceramics Co., Plant No. 2

The principal causes of waste in the ceramic industry may be ascribed to the following sources in the order named: Fuel waste, absence of technical control, inefficient workmanship, lack of standardization, and ignorance of costs.

Improve Firing Methods to Save Fuel

The ceramic industry consumes an enormous amount of fuel in its operations, and the question of efficiency is of great economic importance. Until the war the cost of coal was so low that there was little effort made to improve the methods of firing kilns. When it is considered that heat balances made on various types of periodic kilns have shown that only 5 to 10 per cent of the fuel heating value is used in actually firing the ware, it can be realized that the mechanical means of firing are very far from theoretical efficiency.

The fuel cost is such a large item that the present high prices have stimulated efforts to develop more economical firing methods and more efficient kilns. The

principal trend is in the direction of the railroad tunnel kiln, where the ware travels through a kiln under continuous fire. Large sums of money are being expended to install and perfect this type of kiln. When successful, it has shown a fuel saving of from 25 to 60 per cent as compared with the old periodic kilns. It is still a long road to perfection, but the tendency is in the right direction.

Absence of Technical Control

Many branches of the clay-working industry involve art as well as science, and it is impossible to manufacture these wares along strictly mechanical lines. On account of variations in the raw materials true scientific control is impossible. This makes it even more necessary that every available means of technical control be employed. One of the greatest sources of loss is through lack of knowledge of the raw materials used and the loose methods of uncontrolled manufacture in which too much is left to the human element. Great strides have been made in this direction within the past ten years and the future offers great possibilities along this line.

Inefficient Workmanship Can Be Eliminated Through Co-operation

Much of the higher grades of ceramic wares is partly hand made and its quality and uniformity depend almost entirely upon skilled workmen. The war played havoc with the morale of these workers and their utter lack of interest is today one of the great trials of the manufacturer. Manufacture is carried on under restriction of union shop rules which largely prevent efficient production. This is a problem of management and only better co-operation between management and labor will result in the elimination of many avoidable losses.

Evident Lack of Standardization

The very essence of efficient manufacture is standardized production. On account of the wide prevalence of the raw materials used in the manufacture of many kinds of clay products it is comparatively easy to start a plant. This has resulted in many small units springing up everywhere. Many of these grow by a sort of accretion and the final result is anything but an engineering product. The tendency of modern plants is to adhere to good engineering designs and to accentuate mechanical equipment in every way possible in order to standardize methods at the expense of labor.

In the highest grade wares mechanical standardization is possible only to a limited extent. Here the element of art enters and plays an important part. It is this combination of art and science, together with the difficulties and uncertainties of the processes involved, that makes the industry so fascinating to all connected with it.

Widespread Ignorance of Costs

Perhaps in no other great industry is the knowledge of costs so limited. On account of the long period of time required in the production of a given unit the average cost system becomes so involved and produces such unreliable figures as to discourage its use. The lack of cost figures results in many articles being sold at a loss, while others may be out of line, prices depending largely upon competition. As compared with many other products it is really astonishing at what low figures many ceramic wares are sold when one considers the skill required and the risks and losses involved in the ordinary course of manufacture. The advantages of the use of a uniform system of cost-accounting in the different branches of the industry is recognized and will undoubtedly result in placing the industry upon a much more stable basis commercially.

Metuchen, N. J.

Wastes and Inefficient Practices in the Petroleum Industry

By W. A. Hamor
Mellon Institute of Industrial Research, University of Pittsburgh

Certain wastes and inefficient procedures are observable in the great petroleum industry, particularly in the production of crude oil. It is recognized, for example, that greater supplies of petroleum can be obtained through increased recovery from our oil fields, resulting from the development and application of more effective operating methods, and especially from the elimination of wastes. There is, in fact, a many-sided movement to effect a more rational production of petroleum by scientific study, and there have been begun investigations on the determination of the capacities and characteristics of oil sands, the proportions of petroleum not recovered by present methods of production, and the laws governing the expulsion of petroleum from these sands. But little information exists on this subject, and it will be impossible to interpret data and to evaluate various production procedures until the underlying geochemical laws are better understood. Methods for stimulating production and increasing the recoveries of petroleum from strata, including the effects of vacuum pumping, the employment of compressed air or gas, and the use of water flooding, are receiving more and more research attention; and it will be contrary to experience if some of these efforts are not fruitful in the coming years. At present, geology, the real foundation of a study of production, is insufficiently applied or understood by the average producer, and consequently much of the production is accidental.

Wastes in production also result from the formation of emulsified petroleum in oil wells. Probably all emulsions in wells are formed after the oil has left the sand, and their formation often can be prevented. The broad study of methods for excluding water from oil wells, of the effect of water on production, and of related casing and tubing problems, would likewise lead to economies.

Other wastes in the domain of production engineering include losses of oil in storage, through evaporation, leakage, etc., and losses through fires at the wells and tanks.

How Better to Utilize the Now Available Crude Petroleum

From an economic standpoint, a better utilization of the crude petroleum now available can be accomplished by the pyrolysis of oils now used as fuel into gasoline. Less than one-half of the petroleum produced receives an ideal separation into products. Indeed, the output of gasoline may be doubled or more without increasing the production of crude petroleum.

Pyrolysis is the leading potentiality in petroleum refining, but the ideal pyrolytic or piezopyrolytic process is not a *fait accompli*. Among the common defects of the processes in use are the loss of oil as fixed or

permanent gas, low yields, the formation of undesirable impurities, and the accumulation of carbon. In this connection it is important to note that not enough work is being done in a systematic way to show how to economize in the use of gasoline when made.

Other wastes in refinery operations result from insufficiency in fractionation, chemical treatment and storage. Certainly there should be no abatement of research on the increase of the efficiency of tower stills, condensers and heat exchangers. And then a familiar problem in refining is the chemical treatment of lubricating oils in such a manner as to prevent the emulsions which result when sulphuric acid is employed, and to minimize other losses due to its use. The most economic utilization of the residues from the acid and alkali treatments remains an open field for research; it is surprising, in fact, that these have attracted so little investigational attention and that, even in well-directed plants, they usually are used for fuel. However, in time much of the acid and soda treating will be eliminated from refinery practice.

Pittsburgh, Pa.

Preventable Losses in Petroleum Refining

By Joseph E. Pogue
Consulting Engineer, New York

The petroleum-refining industry represents an estimated investment of between $1,500,000,000 and $2,000,000,000 and in 1920 turned out upward of 20,000,000,000 gal. of products valued at close to $3,000,000,000. The degree of efficiency attained assumes special importance in an industrial activity of this magnitude.

The petroleum-refining industry may be divided roughly into two overlapping parts: one comprising the large, complete, usually long-established plants, making a reasonably full separation of the raw material into the products in commercial demand; the other including the smaller, newer refineries, called skimming plants, that effect a very superficial extraction of values, recovering merely gasoline and kerosene, and lumping together the remaining products as fuel oil. The efficiency of the second type of plant is necessarily less than that of the first.

The preventable losses involved in the refining of petroleum are of three general types:

(*a*) Physical losses of material as a result of improper or incomplete installations, controllable in part by the refiner.

(*b*) Imperfect separation of products resulting in the recovery of more valuable components in a less valuable form, caused in part by faulty processing but in part the result of economic conditions over which the individual refiner has no control.

(*c*) Financial losses arising from idle equipment as a result of excessive installations, controllable in part by better planning.

Analysis of the Preventable Losses

The physical losses of oil in refining, according to statistical records, total about 4 per cent of the crude run to stills. Part of this loss is inevitable, but upward of half represents gasoline vapor included in the still gases, recoverable by methods already in use for extracting gasoline from natural gas. Such methods for some time have been commercially applied in the more progressive refineries and these could be profitably extended to other plants. The fuel consumption in most refineries is also unduly high; proper insulation, the installation of heat interchangers and other improvements would lead to a gain on this score.

The separation of crude petroleum into its maximum range of values is effected in only a few refineries. Full attainment under this head is not commercially possible under present conditions, but many plants could install with advantage fractionating towers that would enlarge their output of gasoline by recovering the portion that is normally left in admixture with the heavier products. The Bureau of Mines has estimated that the average efficiency of gasoline recovery runs from 75 to 95 per cent and that the country's output of gasoline could possibly be augmented as much as 10 per cent by greater effectiveness in distillation. The further extension and development of cracking may also be expected to enlarge the gasoline yield.

The petroleum-refining industry as a whole is carrying the burden of an excessive equipment. For several years the volume of oil run to stills has averaged close to 70 per cent of the installed capacity. Assuming a valuation of $1,500,000,000 for the equipment directly and indirectly concerned with oil refining, the annual cost of this idle equipment, with money at 8 per cent, approximates $36,000,000.

The proficiency of petroleum refining on the whole is not equal to the attainments of many other chemical industries. Such an outcome, however, is an inevitable result of the rapid growth of petroleum output in advance of a balanced set of demands. The discount from full efficiency is largely the result of a bountiful and cheap supply of raw material. With a stringency in raw material an ultimate eventuality, improvements in refining efficiency may confidently be expected.

Need of Technically Trained Men in Salt Manufacture

By W. L. Badger
Director, Evaporator Experiment Station, University of Michigan

It is difficult to point out wastes in the salt industry, because the whole industry is in a state of technical ignorance and disrepair. It is easy to see why this condition exists. Salt was so long a byproduct of the lumber industry and made with waste steam which cost nothing that the idea of applying engineering principles to its manufacture never occurred. The story is told of an engineer who went into a salt plant in Michigan not many years ago and pointed out methods by which steam could be saved. The owner's comment was: "I don't want to know how to save steam. I have too much of it. I want to know how to use more." In too many cases men who were brought up in this atmosphere are still managing salt plants.

Wastes Due to Lack of Technical Control

The most striking single source of waste is the lack of application of engineering principles to the utilization of heat. The grainer process still makes a very large proportion of the total output. While there are certain uses for which the type of crystal which the grainer makes is better suited, there are many cases where grainer salt is used merely because of prejudice or habit. Much of the grainer salt now made might well be replaced with vacuum salt, thereby substituting for single-effect steam economy triple-effect economy or better. In addition to this it would amaze the average engineer to see the lack of application of ordinary engi-

neering principles in many salt plants. Heat-condensed water is thrown away and boilers are fed with cold raw water. Piping systems are many times as extensive as they need be and are seldom properly covered. The application of very ordinary precautions would result in remarkable saving of heat.

Raw material is so cheap that a certain amount of waste here is entirely justified. In most plants, however, a very little care would result in the saving of many tons of salt a day which are now lost through preventable leaks. It is a question whether any system of accounting to keep track of salt entering and leaving the plant will ever be justified.

A third source of waste is the almost complete absence of labor-saving machinery. Salt is still largely handled in wooden carts, pushed by hand. Belt and package conveyors are conspicuous by their absence.

There are many other minor sources of waste which might be enumerated. The remedy for all, however, is the same—adequate technical control. Most salt plants do not need a large technical staff. One good chemical engineer who understood the handling of materials, the handling of heat, the operation of a boiler room and how to make a few simple analyses when the occasion arose would work wonders in the average salt plant.

The industry must come to recognize the need of technically trained men, or most of the smaller plants will find themselves helpless to compete with the one or two concerns that first see the light.

Ann Arbor, Mich.

Efforts to Eliminate Wastes in the Glue Industry

By T. R. Tennant
United Chemical & Organic Products Co.

Having recently passed through the greatest era of wastefulness the world has ever known, there is little wonder that as a nation and as individuals we are experiencing a reluctance to coming back to a normal and sane basis of business transactions. The logical beginning of such a transition is the elimination of waste.

Our province in this discussion is the glue industry, which itself is based on the recovery of waste. Although in this industry waste from various other industries is converted into a valuable commercial product, the process of conversion has not been free from the practice of wastefulness.

Savings of Labor and Materials

As in other industries, savings have been made in labor and material in the last few years: savings in labor by the installation of various machines and rearrangement of equipment to facilitate flow of material through the various processes in the plant; savings in material by closer and more intelligent supervision of materials at each stage of manufacture. This control not only serves a very important part in preventing waste through decomposition, with consequent loss in yields, but has a direct bearing on improvement in quality.

The chemist has played a very important part in the glue industry, particularly in the last few years, and it is through his efforts that intelligent and systematic savings have been and are continuing to be made. There is still work for the chemist, however. The field is interesting and fertile enough to produce rich rewards for both the chemist and the industry.

One point at which a large amount of waste may be eliminated is at the source of the raw material supply. Such raw materials for glue manufacture as are produced at packing houses and tanneries are merely byproducts in these institutions and as such are not given the same consideration that the main products receive. To the glue maker it is a different story. These same byproducts are his raw material, and he is therefore vitally interested in their history and method of handling before they are received by him.

In many instances the improper handling of these materials at the source is due to lack of knowledge of proper methods. The glue maker is in a position to supply the necessary information, and in the interests of conservation is in duty bound to arrange for co-operation with whomever he is dealing. This has been done in isolated cases very successfully, and if the policy were carried out universally it would tend to eliminate waste and be a financial benefit to all parties concerned.

Chicago, Ill.

Outstanding Causes of Waste in the Glue Industry

By R. H. Bogue
Industrial Fellow, Mellon Institute of Industrial Research

No single condition for waste in the glue industry stands pre-eminent, but three conditions prevail which, if eradicated, would constitute a seven-league stride in the direction of industrial economy.

Losses Caused by Poor Technology

On the manufacturing side, the greatest losses arise through a careless disregard of certain principles that are known to constitute the most advanced practice in glue-house technology. Delay between the processes of boiling, evaporating and drying is most disastrous. The liquefying bacteria and molds which develop with awe-inspiring rapidity may bring the grade down sharply in only a few hours. The difference between the grade that should be attained with a given stock under the most favorable conditions and the grade as actually obtained should appear on the books as a technical loss, but this is not commonly done. Such a practice would furnish the most accurate index of plant efficiency. If the losses were necessitated through insufficient equipment, evaporator capacity or the like, there would be indicated in terms of dollars and cents the exact returns that an investment for such needed equipment would be expected to furnish.

Consumer Often Ignorant of Fundamental Properties of Glue

The wastes incurred by the consumer of glue through carelessness or an ignorance of the fundamental qualities of the material are of greater moment and are more to be deprecated than those committed by the manufacturer. The list of unsound glue-room practices is long. The measuring of glue rather than weighing may be fatal upon different lots of glue. The optimum concentration of glue for application upon different kinds of woods has not been sufficiently studied. Soaking is often carried on for too short a period; the upper portions are often dry; the soaking water is often so warm that bacteria injure the product. The temperature of melting is usually higher than necessary, and the melted glue is kept hot for many hours. Experiments show that a glue may lose in joining strength as much as 1,000 lb. per sq.in. by heating for twelve hours at 80 deg. C., or 5 per cent of its original strength per hour of heating. If maintained at a lower tempera-

ture (40 deg. C.), the bacterial decomposition will likewise result in a great weakening of joint strength. And unless the utmost precaution is used to keep all glue utensils perfectly clean, the liquefying bacteria that develop may become a most serious cause of joint failures. Higher joining pressures, evenly maintained, would result in the production of much stronger joints.

Standardization and Specifications Bound to Come

A standardization of the methods employed for the evaluation of glue and the expression of these tests in absolute terms is one of the most urgent of the present-day needs in the glue industry. Such a standardization could result only in good for the entire trade. The manufacturer could again enjoy a reputation based upon mutual rather than upon paternalistic confidence. The consumer would for the first time in history know just what he wanted and know when he received it. Glue would be ordered and sold upon a system of concise specifications, and a designated grade would refer to exactly the same thing, whether addressed to one company or to another. Manufacturers are reluctant to abrogate their long precedent of secrecy and competition through the art of salesmanship to an open competition based solely upon the quality-price basis; but public opinion and men of science are making the demand, and standardization is now a question not of whether it shall come, but of when it shall come.

Pittsburgh, Pa.

Wastes in Paint and Varnish Oils

By Otto Eisenschiml
Manager, Scientific Oil Compounding Co.

All of the paint and varnish oil industries undoubtedly contribute their share of industrial wastes, but there are two representative industries which are particularly worthy of study. The first of these, the chinawood oil industry, is characterized by appalling transportation losses.

Much Chinawood Oil Lost in Transit

Chinawood oil to a large extent is barreled in China and arrives at the Coast in the original cooperage. The waste on the boats due to leakage and breakage is enormous. Anyone that has received a shipment of chinawood oil has been perturbed at one time or another by the consistent discrepancies in the original gross weights and those that were marked on the barrels at the port of entry before the goods were reshipped into the United States. On top of this, it is mighty seldom that a barrel load of this commodity arrives at its final destination without further serious damage. The writer has seen cars of chinawood oil arrive in Chicago time and time again with as many as ten and even twenty barrels completely broken in transit.

To make matters worse, a certain amount of soakage into the staves of the barrels takes place during the months that elapse between the barreling and the consumption of the oil. This waste amounts to from 2 to 11 lb. per barrel.

What a terrific overhead expense this means on the price of chinawood oil!

Many Linseed Oil Plants Stand Idle

The second industry is the production of linseed oil, in which the greatest waste, it seem to me, lies in excessive plant capacity. There are about three times as many flaxseed crushing plants as there are needed to take care of the linseed oil requirements of this country. The result is that most plants stand idle a great deal of the time, thus adding very considerably to the cost of production.

The remedy in the case of chinawood oil seems to be within reach. Elimination of wooden containers and more care in transportation, perhaps with a premium for those train crews whose cargoes suffer the least damage, should help matters greatly. At the present moment union rules are an obstacle to the last-named proposition.

So far as linseed oil is concerned no suggestion can be made. Repeated consolidations have failed in this respect and the permanent closing down of linseed oil mills has always been followed by the erection of new ones.

Chicago, Ill.

Improving the Paint and Varnish Industry

By Robert S. Perry
President, Perry & Webster, Inc., New York

The paint and varnish industry in Civil War times consisted of a few small factories for linseed oil, white lead and mixed paint.

Since the Civil War a continent has been occupied and a hundred million people across the far-flung miles have housed both a nation's families and a nation's activities.

To protect and decorate these new buildings of the great national expansion the paint and varnish industry grew with equal rapidity to enormous proportions.

As for the nation, so also for the paint and varnish industry, the half century of expansion prior to the World War was a period of effort toward increased profit from volume of output rather than from elimination of waste or possible savings in cost. The feverish activities of the World War period marked the definite end of this period for the paint and varnish industry. Maintained and increased success for any concern will now mean concentrated effort to improve commercial service, enhance quality of product and eliminate wastes.

Facts to Be Considered in the Paint Industry

Waste savings must include investment cost in plant for a given output, as well as in labor, power and material. Better design for new factories, and careful engineering design, survey for reassemblage in present factories, are inevitable to meet the problems of investment, of labor and of power.

The recent developments and savings by leaders in the industry in finer grinding of tinting colors must be carried further and must be followed by those who have not yet availed themselves of the consequent better quality and conservation of these expensive materials. Standardization of colors like yellows will save great wastes.

Increased knowledge in colloidal chemistry and physics, and in the characteristics of paint as a plastic solid, as contrasted with its former study solely from the standpoint of a viscous liquid, directs us to question the possibility of ultimately transporting it from factory to consumer in a wrapper instead of in the expensive package of today.

We are now faced with the stupendous sums involved

in the present delivery to and destruction by the consumer of this container, which represents so large a percentage of the cost of the product. The white lead industry, with its use of about 99 per cent of all raw materials, is an example of the possibilities of waste conservation for the rest of the industry, and this high efficiency resulted from dust recovery as a sanitary measure.

Recent Improvements in the Varnish Industry

The heavy fume losses in varnish manufacture have now yielded to accurate knowledge of their nature and value, and about twenty leading manufacturers are now engaged in their recovery and use. The control and recovery of fume have led to control of fire risk and a new type of plant.

The new type of plant, the control of fire risk and the recovery of fume products have decreased varnish plant investment, cost of insurance and cost of product.

This new development of the past three years is rapidly transforming the varnish industry from a great waster to a highly economic and efficient industry.

New York City.

The Waste of the Soap Industry

By J. H. Chester

Considering the manufacturing phase of the soap industry, the lay observer finds the waste extremely small. The processes are chemically controlled at every point and raw materials are purchased on absolute conformance with specification. In the factory, the nigger, or dark-colored material collecting at the bottom of the first-quality soap kettle, is drawn off and re-treated with the second quality batch. The nigger from this in turn passes through the laundry soap process, and the final residue from the laundry soap enters washing powders and cleansers. Washing powders, such as Gold Dust and Old Dutch Cleanser, were originally developed as an outlet to use up the foots from the cottonseed oil industry. They have a legitimate use in the household and serve the industry in the elimination of material wastes.

Manufacturing establishments are well located. Chicago, one of the principal centers, has the supply of fats from the packing houses and is sufficiently near the alkali supply from the Niagara district and midwestern sources. Principal centers east of the Mississippi River are economical locations for soap production and marketing. There is some economy of location on the Pacific Coast, where one or two plants have recently been established.

Materials Without Soap Value Added to Please the Public

The salient waste in this business, however, is created through competition, where each producer, endeavoring to market his own particular product, has educated the public to desire transparent soap, perfumed soap, oatmeal, peroxide, witchhazel and other so-called medicinal soaps for the toilet. Embossed and lithographed art packages add to the expense. The production of transparent soap involves the incorporation of sugar, glycerine and sometimes castor oil. With one exception of foreign manufacture all transparent toilet soaps are cold made and require these substances, which are relatively very expensive and without detergent value.

Perfumery in soap is likewise cheapening in its use and sold at absurdly high prices. So a double waste is incurred with the purchaser paying a higher price for an article having no added soap value for the increased weight. The medicinal soaps do not contain enough of the constituent to warrant so branding and lead to a sense of false security. No germicide incorporated in soap can be as efficacious for removal of bacteria as can mechanical friction on the skin.

There is no distinct line of demarkation between toilet and laundry soap, since one merges into the other by nature of the manufacturing process. Many laundry soaps are put on the market heavily weighted with inert fillers, such as starch, silica and clays, which have no scouring or detergent value. Of course where silica is incorporated admittedly for scouring purposes there is no imposition on the public. The price paid for transportation cost on inert materials mounts to a large figure in the United States each year. On the contrary, white soaps having alkali fillers like soda ash or silicate of soda perform a function in softening the water.

Pure Soap Law Would Prove Beneficial

The best possible compound for soap is made by processing high-grade fats with first quality alkali. But toilet and laundry soaps should be purchased on the guaranteed soap value. Where it is necessary to soften hard water the soda ash or other alkali should be added separately. Were an act similar to that governing pure food and drugs enforced for soap products, it would work an economic benefit alike to users and reputable manufacturers.

There is no excuse today for low titer oils not being used, because they may all be hydrogenated to any degree of hardness desired. One form which research is now taking deals with the possibilities of the saponification of mineral oils. There will no doubt be discoveries from research laboratories which will permit of even better and cheaper methods of manufacture and treatment of raw materials, but after all is said and done, the greatest waste lies in the misleading of the public by the manufacturer overanxious to outstrip his competitor in the disposal of products.

How the Fertilizer Industry Can Prevent Wastes

By Charles H. MacDowell

President, Armour Fertilizer Works

In common with all commercial ventures, the fertilizer industry has many opportunities for waste and often makes the most of them. It is a heavy chemical industry, manufacturing and selling plant food on a guaranteed analysis. It receives no pay for overruns and is docked for under-analyses. The old-time superintendent was sure he could determine the analysis of a variable material by looks and taste. He was wrong, but there are some old timers still at the helm. They refuse to adopt chemical control. Study of state inspection reports shows many costly overruns and comparatively few underruns. The industry gives away millions of dollars of plant food above reasonable safety provisions.

Strict Chemical Control Needed

Plant losses begin with incoming material purchased on an average-lot-analysis basis. The values contained in one car often differ from those of another. This variation should be known. Shrinkage in weight in

handling and manufacturing starts at once. Average shrinkage should be ascertained and figured. Sulphuric acid yields may be good or bad, with niter consumption high or reasonable. The relation of iron to alumina in phosphate rock affects the availability and mechanical condition of acid phosphate. Fine grinding has much to do with obtaining low insolubles. Different rocks require varying quantities of sulphuric acid to obtain lowest costs and highest availability. Knowledge of what's going on in a factory can be obtained only by a strict chemical control.

In formulating mixtures a procedure based on careful weighing of ingredients of known analysis through mixing, and check analyses after mixing, including further balancing if needed, is the big enemy of waste in the mixing department and the good friend of profits. Again chemical control is the answer.

Accurate Weighing and Careful Inspections Pay

In handling incoming ingredients and outgoing finished product the man at the scale, if he is careless, makes dents in black figures during good years and increases the red in bad ones. Under normal conditions the industry fills 90,000,000 sacks of product. An overrun of a pound to the bag (and an over-industrious worker filled with speed mania can easily accomplish this) would mean giving away 45,000 tons of product worth fully $1,350,000.

Avoiding waste in manufacturing comes from knowing what you sell as well as what you pay for, keeping fully informed as to your work and yields, careful inspection of machinery to avoid breakdowns and to save power consumption, accurate weighing, avoiding false motions in labor handling and keeping your superintendent advised as to costs on differing outputs that he may cut his cloth properly.

Poor Cost-Accounting Discredits the Industry

As to cost-accounting: Like the overcoat in the expense account, all cost items get into the ledger some time and often too late for safety. Known costs are checked out daily, but unless deposits are annually made for hidden items of cost the unwelcome "no funds" notice comes to hand too soon for pride or for financial comfort. Often charges for interest on investment, or on stocks, are not taken into consideration in plant-accounting. Buildings, machinery and outside equipment are subject to heavy depreciation, and charges should be spread over the life of the plant to take care of these costs. Obsolescence is an item few makers consider. Depreciation reserves figured annually should be set up for the unusually heavy replacement year.

Companies that do not figure these items properly are fooling themselves and are apt to accept business on a basis of actual loss when they think they are making a profit. Such sales demoralize markets and discredit the industry. Steps are being taken by the National Fertilizer Association to work out a rational cost-accounting system which should show up much of the waste of manufacturing. This, together with chemical control and rigid plant and process inspection, should do away with many losses and tend to stabilize conditions. Do the thing right, know that it is being done right, know what it costs to do it and many present-day ills will disappear.

Chicago, Ill.

The Lumber Industry—A Flagrant Waster

By Earle H. Clapp
Assistant Forester, U. S. Forest Service

American industry and the American public in their use of forest products have been and still are as prodigal as Nature herself. Not more than one board foot appears in finished lumber for every four cut in the woods. Two of the four are left in the woods or fed into the sawmill burner or are lost in seasoning before the stage of rough-seasoned lumber is reached. The third foot disappears during the manufacture of the finished product.

Even greater waste in manufacture is not uncommon. The hickory-handle maker buys two tons of lumber and sells 400 lb. of handles. In many furniture and chair plants unskilled labor plus unskilled supervision net only 70 or 50 or 35 per cent of the lumber received. Similar wastes characterize most all the other wood-utilization industries.

Enormous Wastes Due to Misuse and to Forest Fires

The question may be approached from another standpoint. The building trades alone use annually $200,000,000 worth of timber in general construction where strength is a factor, and have only begun to consider working stresses. Much of the railroad claims bill of $100,000,000 for damaged or lost goods should be charged to faulty containers. Fifty million dollars may cover the annual loss from poor seasoning of lumber. The development and use of preservatives in timbers exposed to decay could be made to save an enormous drain, equal to the annual loss from forest fires. Fire retardants and better construction could likewise largely reduce the $200,000,000 annual bill for fire losses in buildings.

Our losses from forest fires have for the past ten years averaged 1,000,000,000 cu.ft. Furthermore, we allow 81,000,000 acres of forest land to remain an idle waste year after year and even add to it annually something like five to eight million acres. We are satisfied with one-fourth of the easily obtainable growth on 237,000,000 acres additional of cut-over and burned lands.

Much of this enormous waste is pure prodigality. When we have so much, why worry about waste? There is more money in wasteful than in careful use. We have not yet spent our inheritance and we will not go to work until we feel the pangs of hunger. Many seem to think it will be time enough then, provided that Yankee ingenuity has not found substitutes for wood by that time. Excessive waste in the forest industries has first, therefore, resulted from the very wealth of our resources.

Better Knowledge of the Properties of Wood a Sure Remedy Against Waste

The second outstanding cause is our ignorance of wood and its products. Wood has been taken as a matter of course—nothing more has been thought necessary than the rules of thumb handed down from generation to generation. Only during the last decade has there been any real perception of the fact that we are dealing with a complex and variable substance, and of what this means practically. We are beginning to learn that knowledge of the strength properties of wood makes possible great economies, even in so elementary a matter as the making of boxes, for example. Knowledge of the physical properties of wood will solve

our seasoning problems. And finally, we can make the chemistry of wood assist in the utilization of vast quantities of material now waste, not only for pulp and paper, alcohol and other familiar products, but also for purposes now undreamed of, as is exemplified by the recent discovery of a method for converting sawdust into stock feed.

Washington, D. C.

More Pulp Per Cord of Wood—Why Not?

By John D. Rue
In Charge, Pulp and Paper Section, Forest Products Laboratory

The pulp and paper industry stands seventh in the list of great American industries. In 1920 over 7,000,000 tons of paper was produced in the United States, in the manufacture of which 6,114,072 cords of wood were consumed. This wood cost the manufacturers over $116,000,000. One of the prominent examples of waste and inefficiency in this country is found in the present methods of handling and utilizing our forests. The pulp and paper industry is a large contributing factor in the production of this waste, since 8 per cent of the annual cut of timber goes into the manufacture of paper. Each cord of wood cut contains a certain quantity of potential paper-making material. When manufactured into ground wood pulp, all but the water-soluble portion, or approximately 96 per cent of the wood, exclusive of the bark and knots, could become paper. When manufactured into chemical pulps, probably between 55 and 60 per cent of the wood could become paper. Anything less than these amounts really constitute a waste. Let us consider the causes for such wastes and how far they might be avoided.

It is comparatively easy to point out the location of the losses, but, unfortunately, the methods of measuring the wood used and the pulp produced, especially the former, are so inadequate that no real knowledge of percentage yields can be obtained. Such information is most essential, however; for an accurate knowledge of existing conditions is prerequisite to improving these conditions.

Waste Caused by Decay During Storage

If we start our consideration with the pulpwood after it has been cut, we will find our first source of loss in decay during storage. A certain amount of decay in the wood as received must be expected, for the pulp industry cannot compete with the lumber industry for the finer grades of wood. Lack of proper care in handling and storing is responsible, nevertheless, for large decay losses. The wood loses in weight, causing a proportionate loss in the possible yield of ground wood pulp as well as a loss in the quality of the product. Furthermore, the destructive organisms have a selective action on the cellulose, so that the potential yield of chemical pulp is reduced. Losses from the decay of pulpwood and wood pulp are estimated at at least $5,000,000 per year, and could to a large extent be prevented, provided more were known about proper methods of handling and storing the various species, and more of that which is known were put into practice. Investigations of preservative treatments for ground wood pulp have already indicated most encouraging results in the prevention of decay during storage.

In the grinding of wood losses are met with on account of the production of excessive amounts of fine wood flour and of large slivers. More efficient control, as well as improvements in the quality of the stone and in its care during operation could do much to lessen these losses, which amount to over 5 per cent, or 75,000 tons per year, valued at $3,000,000.

Improving the Methods of Pulp Manufacture

The fundamental object in using chemical processes in the manufacture of pulp is to produce a pulp of greater durability and of higher quality than is possessed by ground wood pulp. Approximately 55 to 60 per cent of the weight of the pulp consists of cellulose, and it is reasonable to expect that it should be possible to obtain this amount of a white pulp product. Higher yields should be obtained when a less pure product will suffice. As a matter of fact, in practice less than 45 per cent of the wood is obtained as high-grade pulp, or less than 75 per cent of the potential yield. In other words, the wood consumed during 1919 should have produced 600,000 tons more than the 2,000,000 tons actually obtained, which on a very conservative estimate would represent a value of $30,000,000. It would not be fair to the pulp manufacturers to estimate that this loss is entirely or even largely due to inefficient methods of operation, although it is true that through a more thorough system of technical control much saving could be realized both through improved yield and through improved quality of product. It is fair, however, to charge the industry with a large portion of this loss, because it has failed to prosecute vigorously the scientific investigations necessary to unfold the underlying principles of the processes. Such knowledge is fundamental to the rapid improvement of pulp manufacturing processes and to the design of efficient plants and equipment.

It is a regrettable commentary on the industry that the past fifty years has seen so few changes in the pulping processes. With the exception of an increase in the size of units and in the rapidity of production, pulp manufacture today stands practically where it stood during the last quarter of the nineteenth century. There are evidences, however, of an awakening to the need for intensive investigations along these lines which give promise of greater progress in the future.

More Favorably Located Species Must Be Used if Possible

Any discussion of the inefficient utilization of wood in pulp and paper manufacture would not be complete without emphasizing at least one other factor, a factor which when fully appreciated is most startling. Fifty-six per cent of all the pulp wood consumed is spruce. If we include with spruce hemlock and balsam fir, these three species constitute 77 per cent of the entire pulpwood consumption. The significance of these facts becomes evident when we realize that the supply of these species comes almost exclusively from the northeastern section of the United States, and that it is estimated that this supply constitutes only 3 per cent of the entire wood supply of the country. The drain on this limited number of species is causing their rapid depletion. Pulp mills which were a few years ago in the heart of their pulpwood supply are now forced to haul their wood long distances and in many cases past large stands of available timber, which, however, are considered undesirable for pulping. This state of affairs means lower profits to the manufacturer and higher prices to the consumer. Here again intensive investigation and research are needed to point the way to economic means of utilizing more favorably located

species. In a field of such wide application and universal interest the highest degree of co-operation in such investigations is desirable, if not imperative.

Northern Pines the Most Promising Possibility

Species that are to meet satisfactorily the demands for pulpwood must be favorably located with respect either to present mills or to the pulp markets. An increased supply of spruce, hemlock and fir can be found only in the far West; too far from present mills and too far from present pulp markets to warrant the extensive building of new mills.

A goodly supply of hardwoods is available especially in the Central and Southern States, but the shortness of their fiber greatly limits their field of usefulness. The pines, however, still remain as an important possibility. If the Northern pines could be satisfactorily used, the supply of pulpwood to the mills now using spruce, hemlock and fir would be immediately doubled. Five times as much more pine is available in the Central, East Central and Southern States. These localities would be within range of pulp markets and the supply of pulpwood could be obtained without undue competition with the lumber industry. Here again the one outstanding need is for intensive research to blaze the trail to successful utilization.

Sins of omission are quite as grave as those of commission. The fact that the industry has failed to provide for an early solution of these problems does not relieve it one whit from the responsibility for the inefficiencies and waste which this failure involves. It is a matter for great encouragement that the leading organizations of the industry are turning their attention to these problems. The need is urgent, and procrastination spells catastrophe.

Madison, Wis.

The Lack of Team Work in the Wood-Distillation Industry

By Frank J. Root

So much has been published on the huge loss of sound wood in form of forest waste and mill waste that one may now merely call attention to the fact that it is one of our foremost extravagances.

In the manufacture of wood-distillation products in the United States good body wood in the form of cord wood has been used at an average rate of over a million cords annually for the last twenty years. This cord wood has been so increasingly expensive and hard to obtain that many makers have curtailed an otherwise profitable production, while some have entirely suspended operations.

Use of Mill Waste Retarded by Lack of Co-operation

The major problem during these twenty years has been to find a method whereby the vast quality of mill waste might be made to replace the disappearing cord wood. This effort has indeed been a battle royal, with three chief participants: (1) The mill owner; (2) the wood-distillation operator, and (3) the technical man. There seems to exist every economic reason why these three should work in entire harmony, but instead they treat one another with suspicion and do not seem able to speak the same dialect. The sawmill owner pleads he is not a chemical man and hence will have none of it. He also holds his waste at prohibitive figures. The wood-distillation men as a class stand aloof from advancement, not only refusing to aid but insisting that their own antiquated methods cannot be improved. This is humorous in view of the fact that their yields per unit of wood carbonized have been steadily declining until they are now 30 per cent below the good yields of twenty years ago. Their sporadic attempts at improvement have been for the most part ill-advised repetitions of well-known mistakes.

Causes of Failure Should Be Studied

What, then, is the answer? Suppose a case in which John Doe spends $80,000 or $100,000 in an attempt at betterment, which fails utterly and the plant passes to the scrap heap. A little later Richard Roe (who does not know John Doe) feels the urgency of improvement and begins a similar campaign, carefully avoiding any contact with the lamented John or his history, which he dismisses with the terse term, "failure." Roe proceeds until he, too, is in deep water, only to find he has in effect repeated John's error.

Obviously, this economic waste may be avoided by properly compiled records which shall include failures as well as successes. It may not be pleasant to work in a morgue, nevertheless the resulting knowledge of how the patient died may save the next case. The only way the so-called human race progresses is by beginning where the other chap quit. Refusal to do this results in some of the difficulties from which this industry suffers.

The Saving From Better Recovery of Wood-Distillation Products

Another phase of this interesting history may serve to illustrate the lack of team work: Each cord of wood carbonized yields as an unavoidable byproduct, 12,000 to 15,000 cu.ft. of gas. When leaving the retort this gas carries with it all the liquid values, including the wood alcohol. To reclaim these values from the gas an ordinary water-cooled surface condenser alone is employed. This serves to remove a large portion of the liquids, but unfortunately not nearly all. The gas mass, still saturated to its dew point with both alcohol and acetic acid, goes directly to the fireboxes and is burned as fuel.

About twenty years ago a method was worked out whereby these liquids were reclaimed from the gas and at the same time the vapor tension on the retorts was accurately controlled, the net saving amounting to a 10 per cent increase in products made. This work was done on a commercial scale and installed in a small group of plants, where it continued to make its regular 10 per cent saving year after year.

With a record like this one might expect to see every plant similarly equipped, but sad to relate the number so equipped has never been materially increased.

The loss so incurred may perhaps be best visualized if stated in terms of trees: each year the industry thus unnecessarily cuts 5,000 acres of good standing timber. In the twenty years under discussion it has cut 100,000 acres.

This protracted sacrifice appears to the writer to be in the same class as the drain on the productive land of India by the keeping of vast herds of "sacred" cattle which produce nothing. We condemn the Indian's attitude. What shall we say of the American parallel situation? A small amount of team work by the parties interested would soon correct this waste and avoid another twenty years of extravagance.

Chicago, Ill.